EXAMINING OUR PROGRESS

UNIVERSITY OF MICHIGAN · ANN ARBOR · PROTOTYPE SUSTAINABILITY REPORT · MASTER'S PROJECT · 2002

JUNE · 2002

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A Prototype Sustainability Report
for the University of Michigan Ann Arbor Campus

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Prepared as a component of a Master's Project submitted
in partial fulfillment of requirements for the degree
of Master of Science in Natural Resources and Environment,
the University of Michigan

With support from:
Center for Sustainable Systems
Occupational Safety and Environmental Health (OSEH)
Wege Foundation

June 2002

Available electronically at:
http://css.snre.umich.edu/css_doc/CSS02-03.pdf

THE UNIVERSITY OF MICHIGAN
SCHOOL OF NATURAL RESOURCES
& ENVIRONMENT

OFFICE OF THE DEAN

July 3, 2002

This letter is provided to underscore and give emphasis to the excellent efforts of the team of four School of Natural Resources and Environment {SNRE} Master of Science students, Sandra Rodriguez, Matt Roman, Samantha Sturhahn, and Elizabeth Terry, who prepared this Prototype Sustainability Report for the Ann Arbor Campus of the University of Michigan. This document is a component of their Master's Project undertaken over an 18-month period to partially fulfill requirements for the degree of Master of Science.

The concept of a Sustainability Report for the University of Michigan originated at the first meeting of the Economicology Group of now twelve colleges and universities convened by Mr. Peter Wege and the Wege Foundation at Aquinas College in Grand Rapids, Michigan on April 20, 1999. Following this meeting, preliminary research on the concept of a sustainability report was undertaken by an SNRE graduate student working at the Center for Sustainable Systems. In January 2001 the present team formed to carry out the full Project effort.

The process established by the students built strong relationships with key staff personnel in over thirty units and departments at the University. The data obtained from these contacts throughout the university enabled the students to establish a solid baseline for evaluating the sustainability of the Ann Arbor campus. These students developed a set of environmental, economic, and social sustainability indicators that in the fullness of time will enable the University to measure and monitor progress toward a more sustainable campus.

Our society now faces a complex set of sustainability challenges including energy security, climate change, biodiversity loss, and water availability. Achieving a more sustainable society requires the application of our very best minds to work upon these problems. This team has demonstrated exceptional intellectual capabilities, critical analyses, innovative and creative approaches, and professional skills in providing this document for our use. I hope this type of report can be institutionalized on a regular basis here at the University of Michigan.

I congratulate each of the team members on their very successful and productive efforts. This is a project very well done!

Sincerely,

Rosina M. Bierbaum, Dean
Professor of Natural Resources and Environmental Policy

ACKNOWLEDGEMENTS

This report was prepared in close collaboration with these and other departments at the University of Michigan:

Bentley Historical Library

Central Power Plant

Department of Public Safety

Dining Services

Division of Research Development and Administration

Edward Ginsberg Center for Community Service and Learning

Facilities and Operations

Financial Operations Plant Fund

Financial Reporting Office

Grounds and Waste Management Services

Human Resources and Affirmative Action

Intercollegiate Athletics

Investment Office

LS&A Environmental Studies Program

Marketing Communications

Matthei Botanical Gardens

M-Stores - Central Stores

M-Stores - Food Stores

Nichols Arboretum

Occupational Safety & Environmental Health

Office of Budget and Planning

Office of Gift Administration

Office of Government Relations

Office of the Registrar

Plant Landscape

Printing Services

Property Disposition

State Outreach Office

Transportation Services

Health Services Waste Management and Recycling

U-M Press

University Employee Relations and Compensation

Utilities and Plant Operations

The following members of our Steering Committee generously donated both their time and expertise in the form of several peer reviews during the course of this project:

Terry Alexander	Occupational Safety and Environmental Health (OSEH), University of Michigan
Andy Berki	Occupational Safety and Environmental Health (OSEH), University of Michigan
Laura Berry	National Vehicle and Fuel Emissions Laboratory, US Environmental Protection Agency
Jonathan Bulkley	Center for Sustainable Systems, University of Michigan
Rob Frederick	Corporate Governance, Ford Motor Company
Robert Gray	School of Public Health, University of Michigan
Julian Keniry	Campus Ecology Program, National Wildlife Federation
Greg Keoleian	Center for Sustainable Systems, University of Michigan
Chris Kolb	State Representative, 53rd District
Jaymie Meliker	PhD Student University of Michigan
Scott Noesen	Sustainable Development, The Dow Chemical Company
Barbara Stanton	Detroit Free Press Editorial Department, (retired)
Bill Verge	Purchased Utilities, University of Michigan

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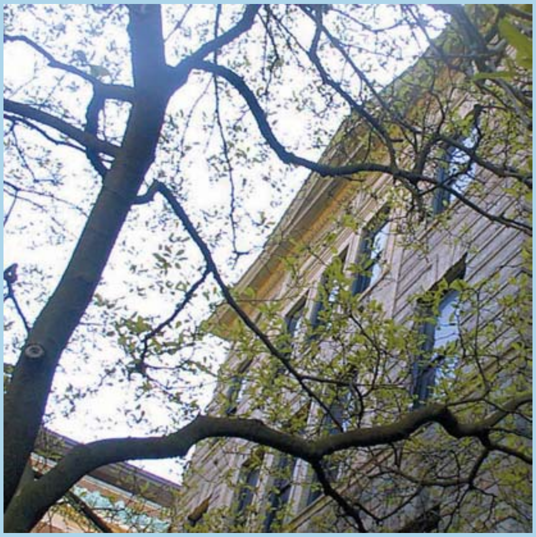


INTRODUCTION

Founded in 1817, the University of Michigan (U-M) is an internationally renowned research and undergraduate, graduate, and professional educational institution with a broad curriculum in the liberal arts. Spanning three campuses in Ann Arbor, Flint and Dearborn, the U-M's mission is:

> *"…to serve the people of Michigan and the world through preeminence in creating, communicating, preserving and applying knowledge, art, and academic values, and in developing leaders and citizens who will challenge the present and enrich the future."*[I]

The primary goal of the U-M is to fulfill this mission. Increasingly, however, it has recognized as a priority the need to do so in a way that is sustainable. Developed with the invaluable assistance of over 30 departments within the U-M and the peer review of a diverse group of external stakeholders, this report introduces a framework and indicators for assessing the "triple bottom line" sustainability of the U-M, and presents a first assessment of the U-M's historical and current performance.

1.1 What Is Sustainability?

In 1987, the UN-appointed World Commission on Environment and Development defined sustainable development as "…development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[II] The foundation of sustainability consists of three fundamental premises:

- Continued development depends upon **the availability of critical inputs** that fall into one of four categories[III]:

  Ecological – renewable resources and services[IV] that are provided by healthy natural ecosystems

  Material – non-renewable resources

Human – knowledge and the means, including income, health, human rights[v], freedom[vi], and opportunity, to apply that knowledge

Social – trust, reciprocity norms, equity, and other conditions that permit coordination and cooperation for mutual benefit

- That there are **limits** to the availability of finite material resources and to the regenerative capacity, or carrying capacity, of ecological resources
- Ecological, social, and economic systems are interdependent **complex systems**.[vii]

Building on this foundation, sustainability can be defined as[viii]:

- Ensuring that there are sufficient supplies of the above resources necessary to allow humans to meet basic needs and to support continued development, and
- Ensuring that access to this sufficient supply of resources is equitable both intragenerationally (among all members of the current generation) and intergenerationally (between this and future generations).[ix]

1.2 Why Is Sustainability Important?

The importance of sustainability can be defined in two ways. First, sustainability can be seen as important because of the high cost of the alternative – deteriorating social, environmental, and economic systems. For example, anthropogenic releases of greenhouse gases are predicted to cause global temperature increases (a phenomenon referred to as global warming), which in turn threaten to raise sea levels, shift agricultural production zones, and increase the frequency of severe weather events. Increasing inequities in income distribution and education threaten to destabilize human and social resources and compromise continued human development.

Second, sustainability can be seen as a source of innovation and new opportunities to improve the rate and extent of human development. Often referred to collectively as the "business case for sustainability", these opportunities include:

- Cost savings due to dramatically improved efficiency
- Risk reduction
- Identification of new markets for new products and services
- Enhanced reputation, leading to improved customer acquisition and retention and improved access to financial markets.

"…to serve the people of Michigan and the world through preeminence in creating, communicating, preserving and applying knowledge, art, and academic values, and in developing leaders and citizens who will challenge the present and enrich the future."

The University of Michigan mission statement

1.3 Moving Toward Sustainability

As evidence mounts that sustainability is of critical importance to continued human prosperity, entities such as governments, communities, corporations, and universities are articulating principles of sustainability to guide their actions and making commitments to improve the sustainability of their operations. Among the most well-subscribed standards for sustainable business operations are the Principles developed by the Coalition for Environmentally Responsible Economies (CERES), the United Nations' Global Compact,

Figure 1-1 Chronology of Select Sustainability Initiatives at University of Michigan

1960	**Peace Corps Concept Introduced**
	Presidential candidate John F. Kennedy introduced the idea of a Peace Corps on the steps of the Michigan Union.
1964	**Center for the Education of Women Established**
	U-M established the nation's first comprehensive, university-based women's center of its kind, with a commitment to helping women further their educational and employment goals, and a focus on research and advocacy for women.
1970	**First Earth Day Celebration**
	U-M became the national center of planning for the first Earth Day and held seminars that addressed new issues in environmental education.
1970	**U-M Offers Public Transportation Options**
	U-M began sponsoring vanpools for U-M employees that operate from six outlying communities in the 1970's. Today, U-M also provides free bus services (U-M blue busses are free to all U-M affiliated individuals; faculty and staff may elect free passes on city busses).
1973	**Project Community Launched**
	Created by the Division of Student Affairs and the Department of Sociology, Project Community is one of the longest running, academically-accredited service-learning courses in the nation. Each year more than 600 students combine academic learning with meaningful service in the community.
1987	**Energy Conservation Project Account Created**
	The ECPA self-sustaining fund pays for energy efficiency improvements in U-M buildings. In 1996, the ECPA received a DOE National Energy Efficiency and Renewable Energy Award.
1989	**Recycling Program Launched**
	The U-M's Recycling Program began with the collection of white office paper, newspaper and corrugated cardboard, and has now expanded to include many other materials.
1989	**Solar Car Team Created**
	U-M's Solar Car Team is a non-profit, student run organization whose purpose is to design, finance, build and race a solar powered vehicle in competitions in the US and globally.
1990	**Solar Car Team Wins Races**
	U-M's solar car, Sunrunner, won 3rd place in World Solar Challenge and 1st in the GM Sunrayce. In 1993 U-M won 1st price in the Sunrayce again. Since then, it has gone on to finish highly in many US and world competitions.
1992	**Corporate Environmental Management Program Launched**
	The program provides business students the opportunity to become better informed about environmental issues and natural resources students an opportunity to achieve a greater understanding of the business world. Students take core courses in each School and in other ways intellectually connect business and the environment.
1995	**Energy Fest Program Launched**
	Energy Fest is an annual one-day event intended to educate the campus community about energy conservation measures used by the U-M.
1995	**Salt Use Quality Improvement Team Established**
	U-M's Salt Use Team researches alternate ways to melt snow and ice in conjunction with salt and sand, without jeopardizing pedestrian safety or the environment.

Continues on page 4

FIGURE 1-1 CHRONOLOGY OF SELECT SUSTAINABILITY INITIATIVES AT UNIVERSITY OF MICHIGAN (CONTD)

1998	ENERGY STAR PROGRAM LAUNCHED
	U-M commits to upgrade lighting in all General Fund buildings and implementing other energy conservation measures. Under the program, approximately 25 million KWH of electricity are saved annually, enough to power about 1600 average-sized homes.
1998	DIALOGUES ON DIVERSITY LAUNCHED
	The program, intended to open a forum to discuss issues related to diversity on campus, became digital in March 2002.
1999	U-M AWARDED MAGNA CUM LAUDE STANDING IN ENERGY STAR HONOR SOCIETY
2000	INSTALLATION OF ETHANOL FUEL TANK
	U-M has the largest active alternative-fuel vehicle fleet of any university in the country, and the 40th largest in the country. All U-M buses use biodiesel fuel, and the overall fleet includes electric vehicles and other vehicles that use ethanol instead of gasoline.
2001	JOINT UNDERGRADUATE PROGRAM ON THE ENVIRONMENT CREATED
2001	SOLAR CAR WINS NATIONAL CHAMPIONSHIP AND 3RD PLACE IN WORLD SOLAR CHALLENGE
2002	RECYCLING PROGRAM RECOGNIZED BY NATIONAL RECYCLING COALITION AS BEST SCHOOL PROGRAM IN COUNTRY
2002	THE RESOURCE CONSERVATION CAMPAIGN IN ALL RESIDENCE HALLS DURING THE WINTER '02 TERM, ALSO KNOWN AS ECOLYMPICS, SUCCEEDS

the Caux Principles for Business, and the OECD Guidelines for Multinational Enterprises. Public and private organizations are also identifying ways to assess and report on their performance against sustainability targets, and frameworks like the Global Reporting Initiative are emerging to provide guidelines and standards.

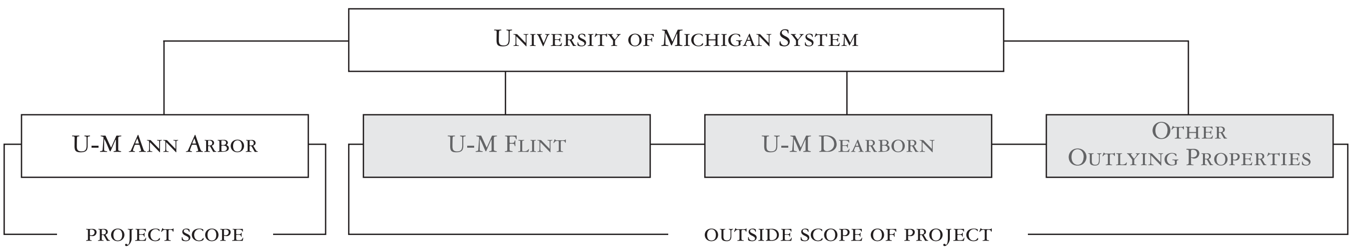
In 1990, university leaders from around the world signed the Talloires Declaration articulating their shared, profound concern for the health of the environment and pledging their intent to lead their universities in playing a "…major role in the education, research, policy formation, and information exchange necessary to make [environmental protection] possible."[x] Today, over 275 university presidents and chancellors from 40 countries have signed the Declaration.[xi] According to the National Wildlife Federation's Campus Ecology Program, over 60% of the institutions of higher education in the United States demonstrate good environmental and/or sustainability practices.[xii] Approximately 270 of these institutions have initiated public reporting efforts that discuss aspects of their sustainability practices.[xiii]

1.4 OBJECTIVES AND ORGANIZATION OF REPORT

The U-M has a long history of leadership and innovation in sustainability issues (FIGURE 1-1). This Report is the product of a Master's Project entitled "Sustainability Assessment and Reporting at the University of Michigan" (the full Master's Project Report can be found in the U-M library system or on line at the Center for Sustainable Systems website, http://css.snre.umich.edu/css_doc/CSS02-03.pdf) the Master's Project was designed to provide the U-M with a framework for assessing and reporting the performance results of its sustainability efforts. The objectives of this Prototype Report are to:

- Raise awareness of sustainability both internally and externally
- Introduce a framework and a set of indicators that can serve as a management tool to monitor progress toward sustainability goals
- Provide information to guide goal-setting and decision-making at different levels of the University of Michigan

Figure 1-2 Identification of Report Scope



In each of the above objectives, this Prototype Report represent only an initial step. Sustainability assessment and reporting is a process that must undergo continuous evaluation and improvement. This Prototype Report is intended to provide a useful starting point for dialogue and baseline information against which future performance can be evaluated.

The remainder of the Report is composed of the following sections:

- Scope
- Framework
- Methodology
- Indicators – discussion and results for Environmental, Social, and Economic indicator categories
- Conclusion

1.5 Scope of Assessment

The University of Michigan is composed of several properties spread primarily over three campuses located in Ann Arbor, Dearborn, and Flint. The scope of this report focuses on the University of Michigan's Ann Arbor campus, here after referred to as U-M AA (figure 1-2). Although leaving such an extensive part of the University of Michigan system out of the study overlooks a significant portion of the overall University system, the variation in location, community makeup, and campus function among U-M's campuses was too great to be captured within the scope of this study.
The system boundary for the Ann Arbor campus was defined as all University-owned and operated land and infrastructure within the city limits of Ann Arbor that is utilized primarily by University faculty, staff, or students. The University of Michigan Health System includes facilities both inside and outside of the defined boundary. Only the U-M Medical School, the three U-M Hospitals, and health centers located within Ann Arbor are included in this report. The system also includes Matthaei Botanical Gardens and Radrick Farms Golf Course. In this report, this system will be referred to as U-M AA.

1.5.1 Profile of the University of Michigan – Ann Arbor

U-M AA offers approximately 6,000 undergraduate and graduate courses each semester. There are more than 225 undergraduate majors and 600 degree programs offered by the U-M AA's 19 schools and colleges.

According to the National Science Foundation, the University of Michigan has been ranked as one of the top three research universities in the nation (in terms of expenditures) for the past decade. U-M AA's research expenditures (including research sponsored by external sources and research sponsored by University funds) are presented in TABLE 1-1. As the table indicates, research expenditures have increased by 91% over the latest ten-year period.

In addition to the education and research activities, U-M AA provides additional services for the campus community. The U-M Housing Department provides food and shelter for 16,000 students. The University of Michigan Health System includes the U-M Medical School and three University Hospitals all located on campus. In addition, there are a total of 25 athletic teams participating in intercollegiate athletics.

From 1990 to 2000 the total campus population increased by 8.9% (TABLE 1-2). These figures include a 4.5% increase in the student population.

The University of Michigan maintains 214 major buildings and 221 apartment buildings in Ann Arbor. As a result of the system boundary limitation, the total building area considered in this study was reduced as shown in TABLE 1-3. The table

Table 1-1 U-M AA Research Expenditures

FISCAL YEAR	EXPENDITURE
1990	$286,082,483
1995	$409,235,763
1996	$441,294,540
1997	$458,478,301
1998	$491,472,206
1999	$499,673,610
2000	$545,418,036

Table 1-2 U-M AA Campus Population

FISCAL YEAR	STUDENTS, UNDERGRADUATE	STUDENTS, GRADUATE AND CONTINUING	TOTAL STUDENTS	FACULTY	STAFF	TOTAL CAMPUS POPULATION
1990	23,196	13,198	36,394	3,708	17,527	57,692
1995	23,575	13,112	36,687	3,923	19,480	60,090
1996	23,590	12,935	36,525	3,952	17,575	58,052
1997	23,939	13,056	36,995	4,005	17,737	58,737
1998	24,015	13,182	37,197	4,107	18,807	60,111
1999	24,493	13,353	37,846	4,281	20,063	62,190
2000	24,412	13,691	38,103	4,342	20,305	62,750
2001	24,547	13,701	38,248			

TABLE 1-3 U-M AA BUILDING AREA

FISCAL YEAR	TOTAL SQ. FT	TOTAL SQ. FT FOR REPORT SCOPE	% INCLUDED IN REPORT SCOPE
1990	22,306,275	21,885,961	98.12%
1995	25,209684	24,784,127	98.31%
1996	25,668,279	25,268,193	98.44%
1997	26,350,901	25,900,680	98.29%
1998	26,623,564	26,134,059	98.16%
1999	26,791,733	26,274,115	98.07%
2000	26,912,087	26,298,312	97.72%

indicates that total facility area for this assessment has increased by 20.2% for the ten-year period from 1990 to 2000.

1.6 Framework

The framework for assessing and reporting on sustainability at the University of Michigan consists of three main components: the "triple bottom line" structure, the use of leading and lagging indicators for reporting, and the application of systems thinking for analysis.

In the broadest sense, the triple bottom line framework rests on the idea that the three spheres of sustainability – economic prosperity, environmental quality, and social equity – are interrelated and overlapping. Thus, in order to reduce negative impacts associated with its activities and, more importantly, to create economic, environmental, and social value, an organization must manage all three spheres and their areas of overlap simultaneously.

This report outlines a set of "performance indicators" (here after indicators) to characterize U-M AA's sustainability performance. These indicators are specific, quantitative where possible, measurements that can be used to track a particular aspect of performance. The report incorporates the concepts of global systems thinking and life cycle assessment. However, it relies on Life Cycle Assessment (LCA) methods to inform both upstream as well as end of life environmental impacts associated with select activities. Due to time and resource constraints all indirect and direct impacts could not be assessed. Generally, the indicators focus either on measuring past performance and results (lagging indicators) or on measuring the extent to which certain activities drive sustainability performance (leading indicators).

1.7 Methodology

To provide a document that can be understood by readers unfamiliar with sustainability assessment, the development of indicators for each category was constrained and should not be considered all-inclusive. The assessment of U-M AA sustainability provides a broad outline of each area studied. In some cases, data sources were limited while information pertaining to certain indicators is not currently tracked. The intent was to create a starting point to provide direction for future analysis. Ultimately, the refinement process will lead to a smaller set of sustainability indicators that function as both a management and communication tool for decision making and assessing the performance of U-M AA to its sustainability goals.

Certain environmental indicators include detailed metrics where such measures are possible, while others are reported at a less specific level of detail. The social indicators include topics that are not as easily characterized using quantitative methods. As a result, some indicators provide specific information while others include only a characterization of the area of importance. Within the economic indicators, the financial metrics introduced are clearly related to the other two dimensions of sustainability that are not reported elsewhere by U-M AA.

1.7.1 Working Definition of Sustainability for U-M AA

For the purposes of this report, sustainability is defined as:

> *…the ability of the University of Michigan Ann Arbor to fulfill its mission and make decisions in a manner that is transparent and equitable, and maintains or improves the long-term quality, diversity, and regenerative capacity of the environmental, social and economic systems that support the University's activities and needs.*

"…the ability of the University of Michigan to fulfill its mission and make decisions in a manner that is transparent and equitable, and maintains or improves the long-term quality, diversity, and regenerative capacity of the environmental, social and economic systems that support the University's activities and needs."

Working definition of sustainability used in this report

ENVIRONMENTAL INDICATORS

2.1 Energy

Indicator 1
On-site energy consumption

Metric 1
On-site energy consumption per capita

Indicator 2
Total electricity used
(separated by purchased vs self-generated)

Indicator 3
Total fuel cycle energy vs on-site energy consumption (electricity and heating/cooling only)

One of the largest impacts of human development comes from energy production, distribution, and use. The United Nations has recognized the growing dependence on non-renewable fossil fuel resources. In September of 1997 the Nineteenth Special Session of the General Assembly of the United Nations recognized the need for a moving toward a pattern of sustainable production, distribution, and use of energy. With the establishment of Multi-year Program of Work for the Commission on Sustainable Development, the UN identified a formal establishment that should contribute to a sustainable energy future for all.

As TABLE 2-1 indicates, US energy consumption represents about 25% of global energy consumption. With just under 5% of the world's population, the United States consumes a disproportionate amount of the available energy supplies. As a result of this imbalance, the US is forced to import roughly 22% of its total energy in order to meet domestic demand[xv]. Clearly, the production and consumption of energy forms require a more sustainable approach than is currently being utilized. At current consumption levels, total fossil reserves could last about 160 years[xvi]. To be sustainable, energy use

Table 2-1 Annual Energy Consumption
source: aer 2000 tables f1b and 1.8.[xiv]

	WORLD 2000 QUADRILLION (10^15) BTU	US 2000 QUADRILLION (10^15) BTU	US % OF TOTAL
PETROLEUM	154.3	38.0	24.6%
NATURAL GAS	90.2	23.4	25.9%
COAL	94.2	22.4	23.8%
NUCLEAR	25.7	8.0	31.2%
HYDROELECTRIC	27.8	3.1	11.2%
OTHER (including wood, solar, wind, geothermal)	5.24	3.6	68.7%
TOTAL	397.4	98.5	24.8%

will have to move away from energy sources that can be exhausted, such as fossil fuels, and toward renewable sources of energy. Solar-related flows are termed renewable resources, indicating that they are inexhaustible as long as the sun continues to burn. Today, the most promising forms of renewable energy include biofuels (fuel derived from plant material), wind, and photovoltaic technologies. Although hydroelectric power is considered renewable there exists some debate about the remaining hydroelectric potential of the world's rivers.

The challenge for universities has been to identify a way to meet the growing demand for energy in a more sustainable manner. The current sources of energy supply do not meet this objective.

The energy necessary to provide electricity, heating and cooling, and transportation for u-m aa comes from multiple sources. The Central Power Plant (cpp), located on Center Campus is a cogeneration facility providing both electricity and heat/hot water for most of the buildings on the central campus. The cpp uses primarily natural gas to fuel the boilers and gas turbines. Some buildings on central campus receive electricity from the electrical grid via a connection through cpp. In addition, the Hoover Power Plant located on campus provides steam heat and hot water to certain campus buildings.

Energy data indicators from the University were prioritized based on two main objectives:

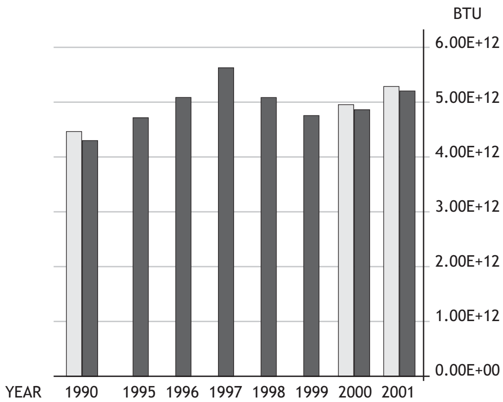
1. To track and manage overall energy consumption and assist with the reduction of the disproportionate amount of fossil based energy that the us currently consumes,

2. Identify renewable and non-renewable sources of energy use in order to identify trends that move the University toward renewable and sustainable energy production and consumption.

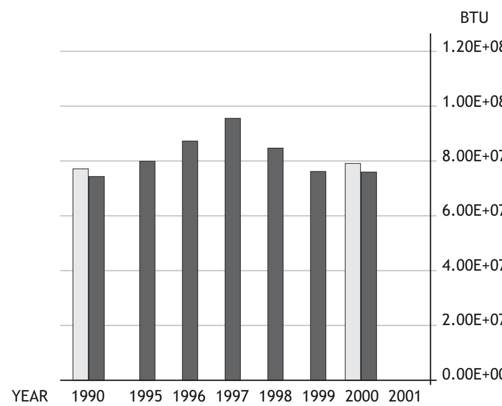
Currently 99% of energy consumption at u-m aa is devoted for electricity, heating, and cooling. Transportation energy consumption through the use of University owned and operated vehicles represents only 1% of overall consumption. For this reason, information specific to electricity, heating/cooling is presented in this document. Energy consumption on-campus is presented in indicator 1. The chart separates total energy consumption, electricity, and heating/cooling by non-renewable and renewable feedstock sources.

Because transportation data is only available for the years 1990, 2000, and 2001 total on-site energy consumption (renewable and non-renewable) is presented for those years

Indicator 1 On-site Energy Consumption



Metric 1 On-site Energy Consumption per Capita



only. For each of the years, renewable energy sources comprise only a small percentage of total consumption (not visible on graph). In 1990, total renewable energy consumption was 2.61×10^{9} BTU out of the total 4.44×10^{12} BTU consumed. However, from 1990 to 2000, total renewable on-site energy consumption has increased by 372%. Total renewable on-site consumption stood at 1.23×10^{10} BTU in 2001. Much of the increase can be attributed to the use of alternative fuels in the University vehicle fleet. During this same time period, total on-site energy consumption grew from 4.44×10^{12} BTU to 4.94×10^{12} BTU, an increase of 11.2%.

One of the additional ways that some indicators can be analyzed is with the use of normalization that present data in relation to a contributing factor. Identified in this report as metrics, METRIC 1 presents on-site energy consumption per capita as an example of this method. Energy consumption was divided by the total U-M AA population, which includes students, faculty, and staff. Year 2000 data were the most recent campus population data available, and, as such, 2000 is the latest year on this graph. From 1990 to 2000, the campus population grew from 57,629 people to 62,750 people, an increase of 9%. On-site energy consumption per capita increased slightly by 2.1% during this period.

Indicator 2 provides a snapshot of electricity consumption at U-M AA. U-M AA has increased the amount of electricity generated on campus from 22% (72.2 MWH) of total electricity consumption in 1990 to 31% (141.6 MWH) of the total in 2001. The U-M AA power plant utilizes waste heat in its cogeneration process, making it a more efficient use of energy than electricity purchased

"US energy consumption represents about 25% of global energy consumption. With just under 5% of the world's population, the United States consumes a disproportionate amount of the available energy supplies."

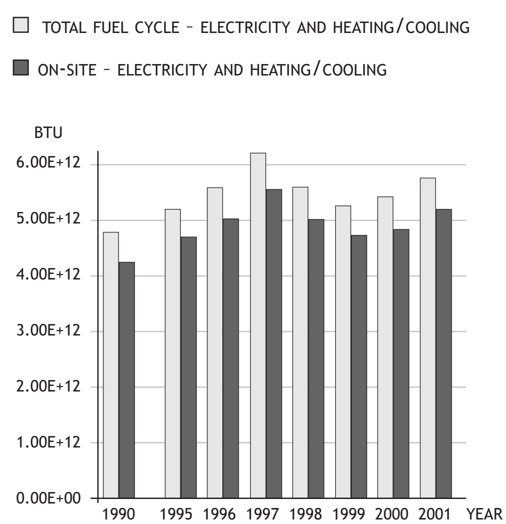
Annual Energy Review 2000

from the grid. Overall, total electricity consumption at the University has remained relatively flat since 1998, stabilizing near the 2001 total of 459 MWH for the past four years.

Two main characterizations of energy use were developed for this report. The first relates to on-site energy consumption. These figures represent the total amount of energy that is consumed within the boundaries developed for U-M AA. On-site energy consumed represents the total amount of electricity, natural gas, fuel oil, gasoline, diesel fuel, ethanol, biodiesel, and liquid petroleum gas consumed within the system boundaries.

The second category used was total primary fuel cycle energy consumption. This figure represents a combination of on-site energy consumed plus the fuel cycle energy associated with upstream activities. Fuel cycle energy is derived using Life Cycle Assessment (LCA) methodology. When applied to an energy fuel cycle, this includes the energy used to remove feedstock (the naturally occurring material from which fuels are derived) material from its original location, the energy used to convert the feedstock into a fuel, and all of the associated transportation energy associated with moving the fuel

Indicator 3 Total Fuel Cycle Energy vs On-site Energy Consumption (electricity and heating/cooling only)



Indicator 2 Total Electricity Used (purchased vs self-generated)

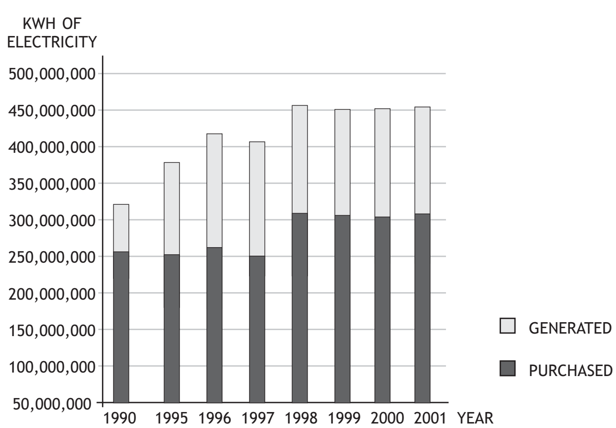
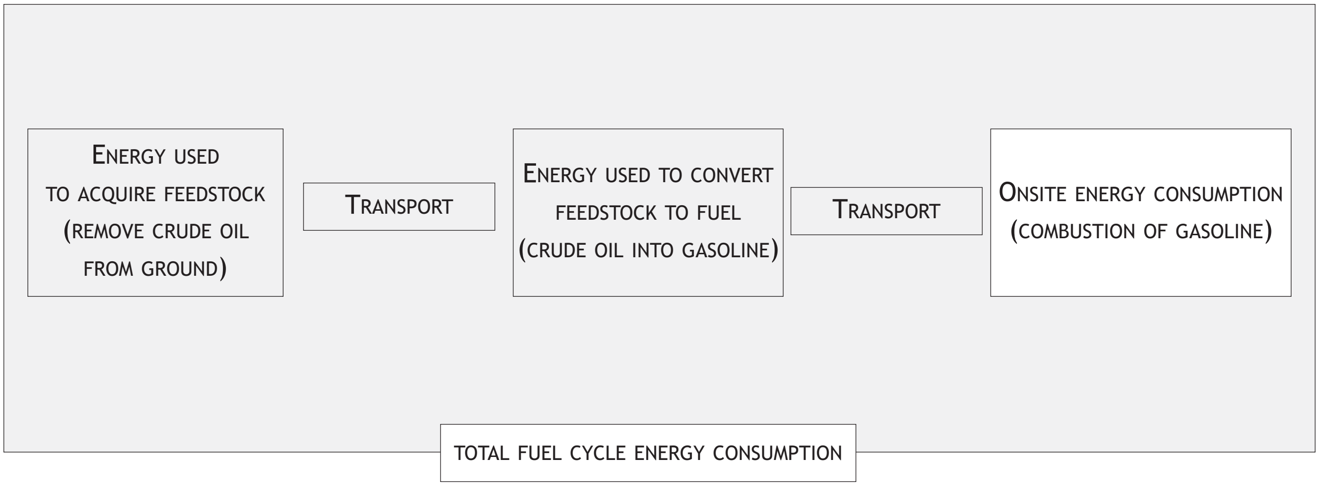


Figure 2-1 Total Primary Fuel Cycle and On-site Energy Consumption



to the point of consumption (figure 2-1). An example of this type of fuel cycle assessment would be a calculation of the energies involved in the consumption of fuel oil: removing crude oil from the ground, transporting it to a refinery, converting the crude oil to fuel oil, and transporting the fuel oil to the point of consumption.

To provide a clearer picture of the amount of additional information that a fuel cycle analysis can contribute, indicator 3 displays the on-site energy consumption and the associated total fuel cycle energy consumption for electricity and heating/cooling. As the graph demonstrates, in 2001, for every unit of energy consumed on campus, an average of an additional 11.8% is required to remove the feedstock from its original location, to convert the feedstock into an energy form that can be consumed, and transport the fuel to where it is needed.

Some sources of significant energy consumption left out of the data include the following:

· Electricity and heating and cooling of non-University owned or operated buildings located on or near campus. This includes satellite medical buildings located within the Ann Arbor boundary. This also includes some restaurants and other facilities located within a University building

· Embodied energy in the production of goods and materials used on campus

· Fuel usage for University mechanical equipment (lawnmowers, tractors, buggies, trimmers, and other petroleum powered landscaping equipment)

· Air or train travel by University representatives (including athletic teams) for University associated activities

· Rental car usage by u-m aa members

· Private car usage by faculty, staff, and students*

· Bus transportation provided to University members by the City of Ann Arbor or commercial organizations*[xvii]

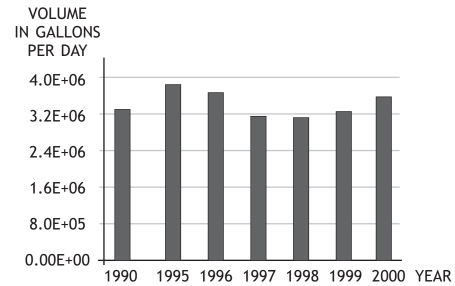
2.2 Water Use

Indicator 4
Total u-m aa water use per day

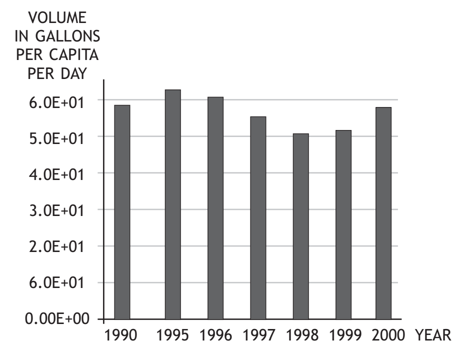
Metric 2
Daily water use per capita

The u-m aa is an institution with a population that exceeds half of Ann Arbor's total population, in which educational, research, residential, and recreational, among other types of activities requiring the use of freshwater occur. The water use level of the University has a significant impact on the ecosystem from which the city of Ann Arbor obtains its water. About 80% comes from the Huron River at Barton Pond (surface water). The remaining 20% is from the Steere Farm wells (hence groundwater) located on the west side of town.

INDICATOR 4 TOTAL U-M AA WATER USE PER DAY



METRIC 2 DAILY WATER USE PER CAPITA



In Michigan, groundwater typically flows from aquifers to replenish rivers, lakes or wetlands. Conversely, surface waters recharge groundwater sources. Land-use activities affecting groundwater quality, especially through infiltration of pollutants, can affect surface water quality as contaminants are carried with groundwater discharge. Therefore, drinking water quality in Michigan requires the protection of surface and groundwater supplies. Business, industry and agriculture all require high quality water for sustainable economic development. It is projected that the Great Lakes Region's reliance on groundwater will increase with continued population shifts, development pressures and demands of a water dependent economy.[xviii] For this reason it is important to monitor and report water use and manage it in a manner that is progressively more sustainable.

Within the U-M AA system, water is used in daily activities such as administrative, educational and housing facilities operation, food preparation, research and teaching laboratories, landscape maintenance, including parks and golf courses, among others. Indirect water use, or water used in the production of other materials consumed by individuals at the U-M AA, is not measured in this indicator. Nonetheless, direct or on-site water use is an important component of sustainable management of this University and it is susceptible to changes related to modifications in the size of the University or in the intensity of its activities. INDICATOR 4 illustrates the trend in total water use per day at U-M AA.

METRIC 2 presents the total daily water use normalized per capita, to weigh U-M AA's population growth effects on the indicator.

Daily water use normalized per capita exhibits a similar trend to that of total daily water use. From 1995-1998, both declined by 17.0%. Between 1998-2000, total daily water use increased by 18.1%, which yields a 13.1% increase when normalized per capita. Cooling at the power plants is the primary water using activity. In fiscal year 1990, steam production at the power plants accounted for 15.8% of all water use. During the years 1990-2000, this percentage shows a net decline of 4.6%.

A brief comparison between U-M AA water use data for 1995 and national, regional (Great Lakes) and state (Michigan) follows. The U-M AA used in 1995 an average of 62 gallons per capita per day. The US national, Great Lakes Region's and Michigan's averages in the same year were 1280, 1500 and 1260 gallons per capita per day, respectively. In terms of total gallons used, U-M AA used 3.7 MG/D whereas at the national, regional and state scales, the averages were 402,000 MG/D, 32,700 MG/D, and 12,100 MG/D, respectively. Between 1990-1995, there was not much change in national total water daily use, whereas there was an 11.3% increase in U-M AA's.[xix] It is important to note that water at scales other than U-M AA is used to support a wider range of activities than those occurring at the University and they may account for the differences encountered. Among these are agriculture, industry, mining, power generation, residential use and others. None of these individual activities resembles completely the University system. It is estimated that US residents use approximately 90 gallons of water per capita per day. U-M AA's per capita daily use, although partially residential, compares favorably.

2.3 Materials Consumed

Indicator 5

Total paper purchased through M-STORES, including recycled-content and chlorine-free paper

Indicator 6

Total paper consumption at U-M AA (estimated)

Indicator 7

Total liquid and solid pesticide applied, by EPA toxicity ranking and PAN BAD ACTOR classification

Indicator 8

Total fertilizer nutrients applied, calendar year 1999-2001

Quantifying the impacts associated with the creation and consumption of materials is complicated by the vast diversity of materials consumed by society and the variety of manufacturing alternatives that exist for most products. In general, impacts associated with the creation (including mining, manufacturing, and other upstream phases) and use of materials fall into two categories – depletion or toxicity. Depletion occurs when the creation and/or use of the material requires the consumption of non-renewable resources (such as, fossil fuels) or the consumption of renewable resources (such as, natural habitat) at a rate faster than their rate of replenishment. Toxicity impacts occur when creation and/or use of the material exposes humans and/or ecosystems to toxic or polluting substances that are harmful to human or ecosystem health. Data regarding the life cycle impacts of the diverse set of materials used at the U-M AA could not be collected for this report. Instead, three types of materials used frequently in university settings were chosen to illustrate impact concepts: paper, pesticides, and fertilizer. However, it is important to note that these three materials do not represent the full range or complexity of products used by the U-M AA or the associated impacts.

2.3.1 Paper Use

Despite innovations, pulp and paper processing still require the consumption of scarce resources and can have negative environmental impacts. The manufacture of non-recycled paper requires significant amounts of virgin wood fiber, energy, and water. Pulp and paper processing also result in chemical releases to air and water. Of particular concern is the use of elemental chlorine in the paper bleaching process and the subsequent discharge of chlorinated compounds, particularly dioxin. Once in the environment, some scientists suggest that chlorinated organic compounds may hinder proper hormonal functioning in exposed organisms[xx]. Paper made from recycled contents offers environmental benefits over virgin-content paper. Recent life cycle analysis indicate that the overall environmental impacts, including energy and material use and releases to air and water, are lower for recycled paper than for virgin paper. Indicator 5 tracks the proportions of all paper purchases made through M-STORES (the U-M AA's central purchasing department) that are made up by recycled-content and chlorine free papers.

While the total quantity of office paper purchased through M-STORES has remained relatively constant at approximately 3 million pounds total over the past three years, the percentage of total purchased paper that contained any recycled content has dropped from 17.2% in 1999 to approximately 12.8% in 2000 to 2001. The use of chlorine-free paper as a percent of the total purchase has remained steady but insignificant at 0.4% over the past three years. These results suggest that efforts to encourage the use of recycled and chlorine-free paper have not made a significant impact on paper consumption behavior.

Indicator 6 estimates overall paper consumption at the u-m aa, including both paper purchased through m-stores and paper use in u-m press publications, u-m aa marketing publications, u-m aa newspapers, and paper use by students in notebooks and textbooks. For the latter calculation, the following intentionally conservative assumptions were made: 50 pages per coursepack or textbook, 1.5 coursepacks or textbooks per class, 50 notebook pages consumed per class, and 10 classes per year (5 classes per semester) per student.

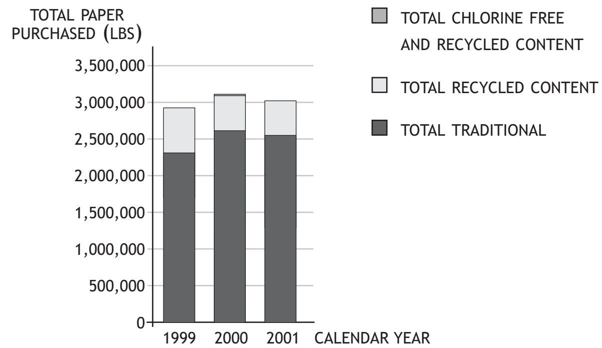
Based on available data and estimates provided by paper-consuming departments (primary research regarding student paper use was not obtained), paper purchased through m-stores constitutes a majority – 60.3% – of overall paper use within the u-m aa system. In addition, traditional (non-recycled) paper is estimated to constitute the majority of total estimated paper consumption. However, this estimate of additional paper use beyond that purchased through m-stores does not reflect the full magnitude of additional paper use, as it excludes many u-m aa publications, paper waste during book manufacture, and may underestimate student paper use.

2.3.2 Pesticide Use

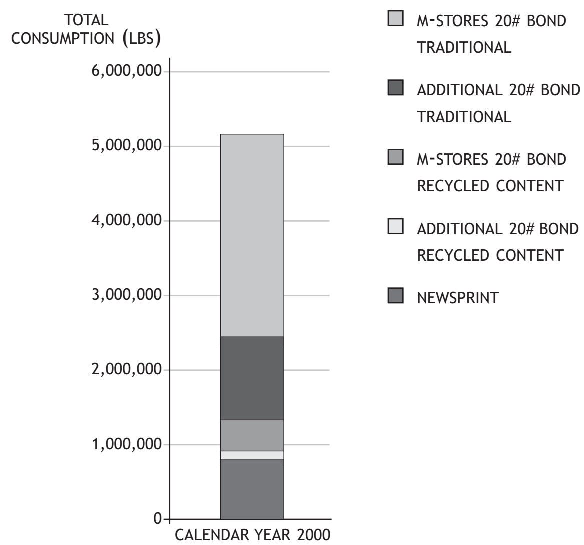
The term "pesticide" applies to any substance or mixture of substances used to control unwanted insects, plants, mildew, fungi, or rodents. When used properly, pesticides play a valuable role in controlling pests. If used improperly, however, pesticides can endanger both human and ecosystem health. They can be harmful to humans and animals if ingested during or after application and can contaminate ground and surface waters.

A pesticide's overall risk depends upon its level of hazard and on the degree of exposure an organism has to the pesticide. Hazard levels and the likelihood of exposure for a given pesticide depend in part upon its combination of physical and chemical characteristics, including its toxicity, its persistence, its solubility in water, its selectivity, or specificity of effect on

Indicator 5 Total Paper Purchased Through M-Stores, Including Recycled-content and Chlorine-free Paper



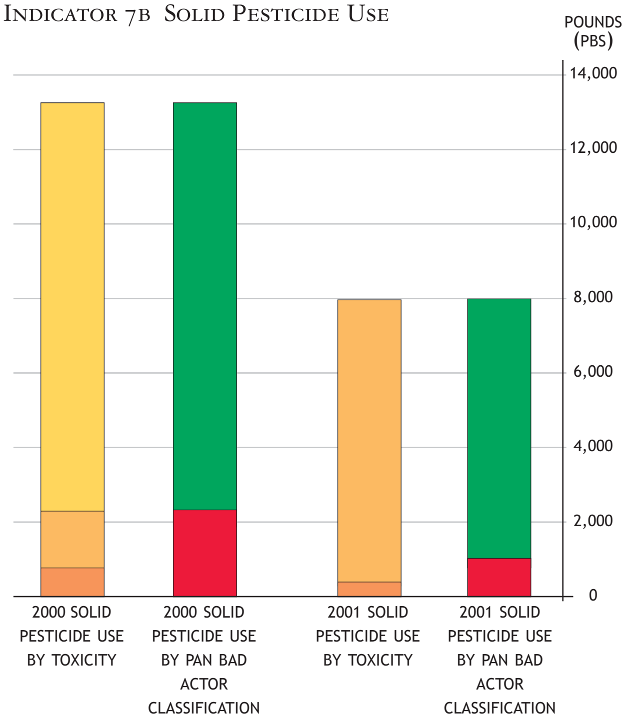
Indicator 6 Total Paper Consumption at U-M AA (estimated)



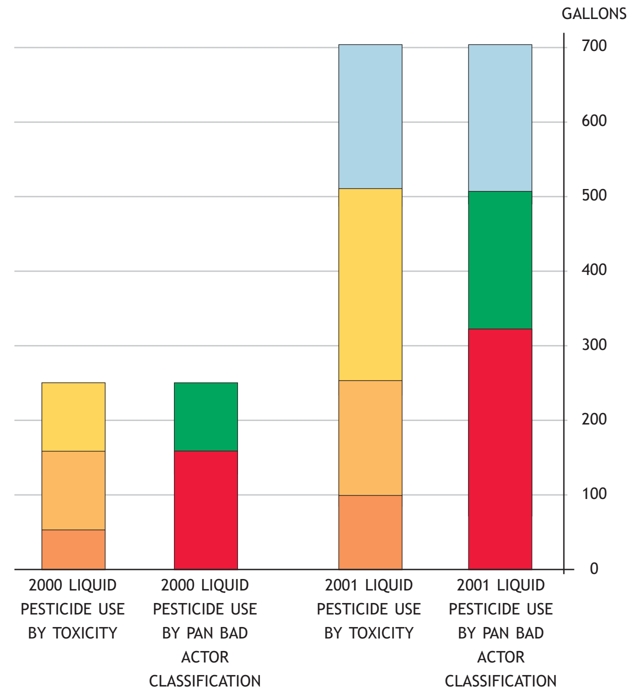
natural enemies, and other attributes. Toxicity rankings and their corresponding signal words (Danger, Warning, Caution, and Not Acutely Toxic) are outlined by the us epa and found on pesticide labels. The pesticide information organization Pesticide Action Network expands this hazard categorization system to rank as "bad actors" those pesticides that can have serious, chronic effects on human and ecosystem health.

Indicator 7 Total Liquid and Solid Pesticide Applied, by EPA Toxicity Ranking and PAN Bad Actor Classification

Indicator 7b Solid Pesticide Use



Indicator 7a Liquid Pesticide Use



- HIGHLY TOXIC
- MODERATELY TOXIC
- SLIGHTLY TOXIC
- UNKNOWN
- PAN BAD ACTOR
- NOT PAN BAD ACTOR
- UNKNOWN

Indicator 7 tracks the overall quantities of liquid and solid pesticides used in outdoor applications and reports the relative hazard of those pesticides. Decreasing the overall quantity and/or the toxicity profile of pesticides used per acre of open space owned by the U-M AA, while holding steady or decreasing the likelihood of exposure and maintaining the functionality of those open spaces, indicates a move toward sustainability. Whether caused by a decrease in the amount of pesticide applied to each acre of managed land or by a transition of acreage from active to natural management, a decrease in the overall quantity of pesticides used lowers overall hazards to ecosystem and human health. The latter, a transition of acreage from active to natural management, would require a significant change in the way that open areas are perceived on the U-M AA campus. As on many university campuses, large expanses of mowed green grass are seen as indicators of a vibrant campus community, and serve as public gathering places. Modifying impressions of what a college campus "should" look like would require significant investment in education and outreach.

The U-M AA adheres to strict Integrated Pest Management principles, following a process of inventorying, monitoring, and non-chemical remediation prior to applying pesticides as a measure of last resort. When pest control measures are needed, U-M AA managers rely first on cultural, mechanical, physical, or biological measures (such as landscaping with more pest-resistant plants). Conclusions about the trend in overall quantities of pesticides applied from 2000 to 2001 are complicated by the fact that quantities of liquid pesticides applied increased by 174%, while the quantities of solid pesticides applied decreased by 40%. In terms of toxicity, applications of Highly and Moderately Toxic liquid pesticides increased from 2000 to 2001, while applications of Highly and Moderately Toxic solid pesticides decreased. The proportion of total pesticides applied that were Highly and Moderately Toxic decreased in both the liquid and solid categories, from over 65% in 2000 to 38.1% in 2001 for liquids and from 18% in 2000 to 7% in 2001 for solids.

The use of liquid pesticides classified as PAN BAD ACTORS increased from 2000 to 2001. While the proportion these pesticides represent within the overall quantity of liquid pesticides applied decreased from 2000 to 2001, in both years liquid PAN BAD ACTORS pesticides were used more frequently than non-BAD ACTORS or pesticides whose status was unknown. Both the total use of solid PAN BAD ACTORS pesticides and the proportion those pesticides represent in the overall quantity of solid pesticides applied decreased from 2000 to 2001.

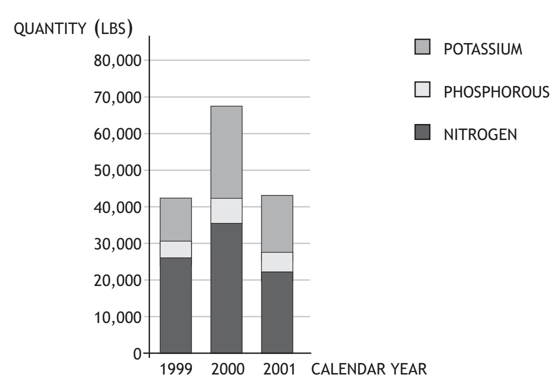
2.3.3 Fertilizer Use

As with pesticides, the use of fertilizers can have positive impacts on the efficiency of crop production, but fertilizer overuse can have negative consequences for both human and ecosystem health. The United Nations Environment Program has indicated that as the amount of fertilizer used approaches the physiological capacity of crops to absorb nutrients, the excess nutrients (nitrogen, phosphorous, and potassium) promote overgrowth of algae in rivers, lakes and bays. The Agency for Toxic Substances and Disease Registry reports that excess fertilizer nitrates that leach from soils into ground water can also cause human health risks, particularly in infants.

INDICATOR 8 tracks the total quantity of each of the primary nutrients contained in applied fertilizers. While exact predictions of the amount and source of fertilizer that is sustainable are difficult, it is deemed a positive trend toward sustainability if the amount of nutrient applied per acre decreases over time and functionality of the managed acres is preserved.

Analysis of the significance of the variation in total amounts of primary nutrients applied per year is difficult. Decisions about nutrient applications are driven by a wide variety of factors, including rainfall, temperature, and other environmental conditions, as well as by aesthetic targets. For example, nutrient applications at Radrick Golf Course increased in 1999 and 2000 because managers were attempting to revive several specific areas of the course.

INDICATOR 8 Total Fertilizer Nutrients Applied, Calendar Year 1999 - 2001



2.4 Food Consumption

Indicator 9

Quantity of food purchased through m-stores by key category (excludes all food purchased from facilities not supplied by m-stores)

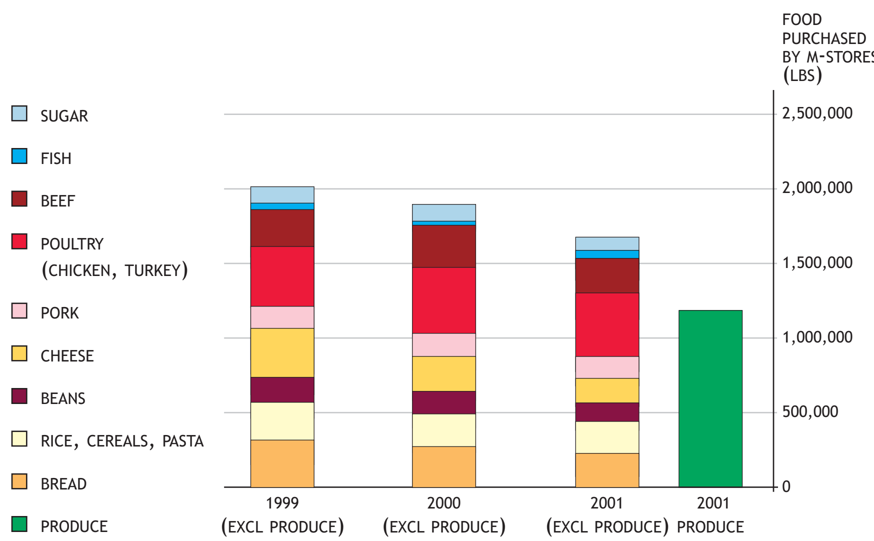
Indicator 10

Ecological footprint of food purchased through m-stores

Human food consumption provides both biophysical (nutritional) and emotional value and provides a context for social interaction. At the same time, food consumption can also have negative social and environmental impacts. In the social sphere of sustainability, unbalanced food consumption can cause malnutrition, obesity, and/or diet-related conditions such as diabetes, all of which result in significant healthcare-related costs and threaten the health of social systems. From an environmental perspective, food production, packaging, and transportation require inputs of water, land and energy, frequently involve the use of fertilizers and pesticides, and can lead to the emissions of greenhouse gases, while food consumption can lead to food waste. One ideal indicator of food sustainability for the u-m aa would be the total (on- and off-campus) quantity of food purchased and the total quantity of food consumed by students, faculty, and staff. This indicator would not only track the amount of food waste generated by the system, but would also provide a complete picture of the food consumption choices being made by the u-m aa community. Because data regarding meals consumed in facilities not supplied by the u-m aa's central purchasing department, m-stores, are not collected at present, indicator 9 instead tracks the overall amount in pounds of each of several key food types purchased from m-stores by u-m aa dining facilities per year.

Interpretation of the total quantity (in pounds) of key food categories purchased through m-stores is difficult. The u-m aa purchases over 425 varieties of non-produce products in a year. Its purchasing system tracked over 1,100 different produce orders during a six-month period. Between March 2001

Indicator 9 Quantity of Food Purchased Through M-Stores by Key Category (excludes all food purchased from facilities not supplied by M-Stores)



and February 2002, U-M AA Dining Halls and Snack Bars served over 1.5 million meals. The quantity of food purchased through M-STORES by U-M AA dining facilities is declining over time, but this could be due to a number of factors. First, the Hospital system has recently begun to purchase food through vendors other than M-STORES. In addition to this documented change, a rise in the consumption of other types of food products not tracked in this analysis, a decrease in pre- or post-consumer waste, or an increase in off-campus dining among meal plan holders could also have had an effect on the quantity of food purchased through M-STORES.

Despite these ambiguities, some observations are possible. While too small to represent graphically, organic produce purchases represented 0.05% of total produce purchases in 2001. This proportion is far below the 1997 US national average of 1-2% of total food sales.[xxi]

While a detailed analysis of other aspects of food consumption, including packaging, transportation, and waste, was not possible for this report, INDICATOR 10 uses a framework called the Ecological Footprint to approximate these aspects within an overall measure of the environmental impact of food consumption. The ecological footprint of any given population is defined as the area (in acres or hectares) of biologically productive land and water that is required to produce the resources consumed. Calculating an ecological footprint involves converting the total amount of fossil energy required to produce the resources consumed to an equivalent land area, and summing that area with the other amounts of land inputs required to produce the resources consumed.

The total Ecological Footprint of all food purchased through M-STORES (including produce) in 2001, assuming approximately one quarter of food purchased is purchased locally and in season, was 18,861 acres.

Analysis of the U-M AA's ecological footprint over time, and the way in which the impacts represented by that footprint are divided between the fossil energy load, consumption of arable land, consumption of pasture land, and use of marine resources, can help the U-M AA to gain a better understanding of the impacts of its food choices.

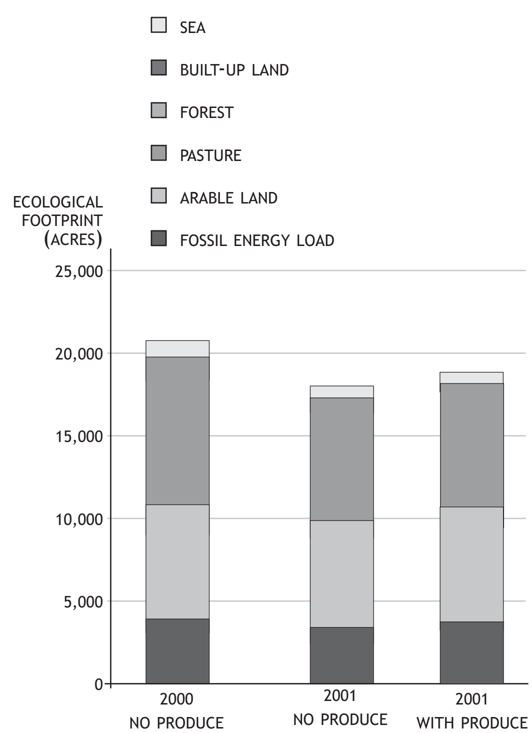
2.5 Land and Vegetation Category

Indicator 11

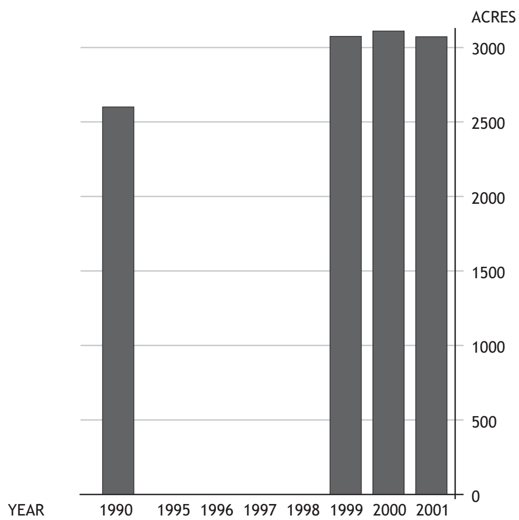
Total land area

Data were gathered on land area, and inferences were made about land use based on that information. The distinction between natural areas and developed areas is important for a number of reasons, including the impacts of developed areas on the healthy functioning of ecosystems. For INDICATOR 11, total land area of U-M AA was assessed with some detail about impervious surfaces and non-impervious surfaces. It is important to quantify land use, including developed and non-developed areas, as a part of the sustainability assessment of U-M AA. Washtenaw County is experiencing rapid land use conversion, mainly regarding changes from agricultural land uses to residential land uses.

Indicator 10 Ecological Footprint of Food Purchased Through M-Stores



Indicator 11 Total Land Area



Impervious surfaces result in increased run-off into bodies of water such as rivers and lakes. At present, water which runs off of impervious surfaces flows into storm drains and directly enters surface bodies of water without having been treated in any way. It may contain a variety of pollutants, including animal waste, litter, oil or pesticides, all of which can have a detrimental impact on aquatic ecosystems. Green space, on the other hand, is able to absorb precipitation which falls upon it. In the case of severe storms, however, some of the precipitation may run off as well. Absorbed precipitation percolates down through the soil and into the groundwater. It is typically naturally filtered as it percolates. Green space also serves other important ecosystem functions, such as habitat for plants and animals, which increases the biodiversity of the campus. Trees have the ability to absorb greenhouse gases, such as CO_2, and thus forested areas can serve as carbon sinks.

Total campus land area for fiscal year 2000 is separated into pervious and impervious surfaces in Indicator 11b. Pervious surfaces on the campus are identified as green space. This category consists of Radrick Farms, Matthaei Botanical Gardens, Nichols Arboretum, Mitchell Field, and managed turf area around campus. This land made up approximately 41.7% of total U-M AA land area in 2000.

Impervious surfaces at U-M AA include buildings, roads, parking lots, and other paved surfaces. Within the impervious surface category, the 40 acres that the University was originally founded on as well as the entire North campus are classified as single units of land, making it difficult to

Indicator 11b. Total Land Area, Separated into Impervious Surfaces and Non-impervious Surfaces - FY 2001 Data

	Area in acres	Area in acres	% of total
TOTAL U-M AA CAMPUS	3129		
GREEN SPACE – TOTAL	1306		41.7%
ARBORETUM, RADRICK FARMS, BOTANICAL GARDENS, MITCHELL FIELD		1154	
MANAGED TURF		152	
PAVED AND IMPREVIOUS – TOTAL	1408		45%
NORTH CAMPUS AND ORIGINAL 40 BUILDINGS AND PAVED SURFACES		623	
OTHER BUILDINGS		785	
ATHLETICS AND SCATTERED LOTS	415		13.3%

determine the amount of pervious and impervious surfaces in each. For this reason, the managed turf acreage of these two units was considered green space and the rest was categorized as impervious surface. Using this classification, impervious surfaces made up about 45% of total land area in 2000. In addition, athletic facilities and certain owned lots were not included in either classification but are shown as a separate category in Indicator 11b.

If the ratio of impervious surface area to total surface area on campus were increasing over time, this would have negative implications in regard to the sustainability of the campus. The data presented show that U-M AA has grown in overall land area since 1990. Maintaining a balance between the facilities necessary to accomplish the goals of the University and providing open spaces is important.

"At a local level, global warming could lead to increased evaporation of surface water, causing deterioration of the Great Lakes ecosystem and a reduction in the local supply of freshwater."

2.6 Emissions

Indicator 12

On-site GHG emissions (includes CO_2, NO_2, CH_4)

Metric 3

On-site GHG emissions per square foot building space (includes CO_2, NO_2, CH_4)

Indicator 13

On-site emissions of criteria pollutants (electricity and heating/cooling only)

Indicator 14

Emissions of toxic and carcinogenic substances to air

The sun conveys energy in the form of sunlight to the earth. The earth also radiates energy back into space. On average, the earth emits about as much energy as it absorbs from the sun. Greenhouse gases in the atmosphere absorb some of the out-going infrared light from the earth. The gases become warmer and emit some infrared radiation back to warm the earth's surface. This "Greenhouse Effect" is a naturally occurring phenomenon, and makes the surface of the earth habitable for humans and other organisms. The greenhouse gas allows most of the sun's light to pass through the atmosphere, but absorbs most of the infrared radiation emitted back from the earth. The naturally occurring greenhouse gases are water vapor, carbon dioxide (CO_2), methane (CH_4), nitrogen dioxide (NO_2) and ozone (O_3).

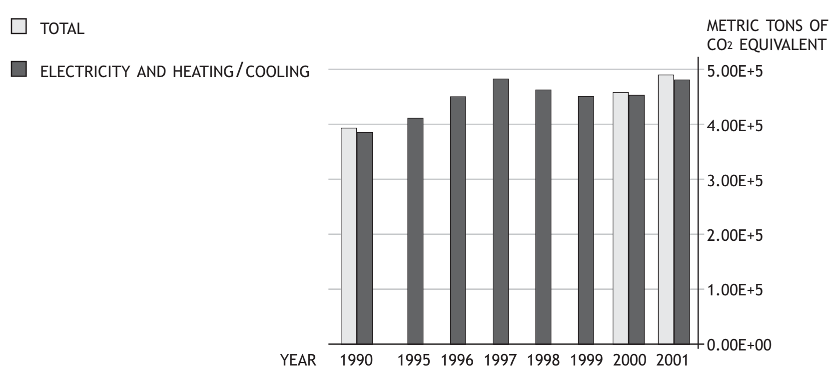
If the concentration of greenhouse gases in the atmosphere increases, the rate of absorption will increase, causing the earth to warm. International experts believe global warming may have serious consequences for life on earth. These consequences could include the flooding of coastal areas due to the melting of the polar ice caps and the resulting rise in sea level. More severe weather events such as hurricanes may become likely and changes in temperature and precipitation that will lead to different agricultural production patterns and to adverse impacts on wildlife. At a local level, global warming could lead to increased evaporation of surface water, causing deterioration of the Great Lakes ecosystem and a reduction in the local supply of freshwater.

At the present time, increases in greenhouse gas concentrations are leading to increases in the intensity of the Greenhouse Effect. The atmospheric concentration of CO_2 has increased by 31% since 1750[xxii]. The concentrations for both CO_2 and methane today have not been exceeded in 420,000 years. As a result of these changes, global surface temperatures have increased 0.5°C over the past quarter century (Barker, Ross 1999). The sources of increased greenhouse gas concentrations are primarily associated with anthropogenic activities. The gases emitted from these activities include CO_2, NO_2, CH_4, halocarbons, and other gases. In particular, the increases in greenhouse gas concentrations have coincided with the widespread use of fossil fuels.

Global Warming Potential is defined as "the time integrated radiative forcing from the release of 1 KG of a trace gas expressed relative to that of 1 KG of a reference gas" (IPCC 1996). Radiative forcing occurs when changes in the net energy input into the earth and atmosphere system force a change in temperature. In other words, a particular greenhouse gas may have the ability to absorb more infrared light and may persist in the atmosphere longer than others, causing more radiative forcing, and thus more global warming. For example, methane is 56 times as powerful as CO_2 at 20 years, 21 times as powerful as CO_2 at 100 years, and 7 times as powerful as CO_2 at 500 years. GHG emissions are commonly reported in "CO_2 equivalents" to provide a way to combine all of the emissions into one unit of measure.

In 1990, total on-site GHG emissions were 3.94×10^5 metric tons of CO_2 equivalent; this figure increased 23% in the period from 1990 to 2001, to 4.86×10^5 metric tons of CO_2 equivalent. This can be compared to an increase in US GHG emissions of about 14% for the ten year time period 1990-2000. For electricity and heating/cooling only, year 2001 emissions were 4.79×10^5 metric tons of CO_2 equivalent. This figure represents the first time that on-site GHG emissions have exceeded the 1997 total of 4.78×10^5 metric tons. As one might expect, the trend data for on-site emissions follow a pattern similar to the energy consumption. The strong correlation between energy consumption and emissions is indicative of a heavy dependence on fossil fuel-based energy.

Indicator 12 On-site GHG Emissions (includes CO_2, NO_2, CH_4)



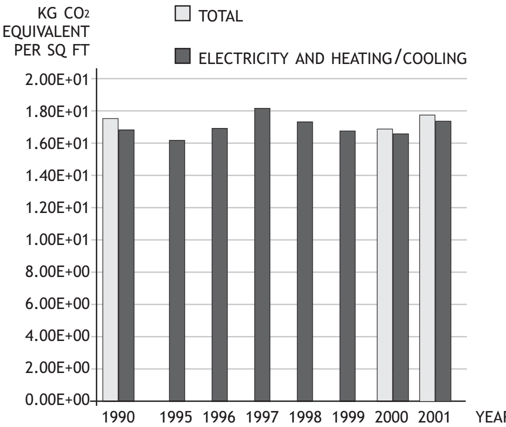
In recognition of the growing problem of global warming, a majority of United Nations members created the Kyoto Protocol. Drafted in 1997, Kyoto calls for a reduction in US emissions of greenhouse gases of 7% from 1990 levels. Developing countries do not have quantified targets. In 2001, the US pulled out of the Kyoto Protocol, which has seriously threatened its viability. Various stakeholders, including student and alumni groups, are pressuring the University of Michigan to comply with the Kyoto Protocol to demonstrate its commitment to sustainability. A U-M commitment to comply with the Kyoto Protocol would be controversial. The growth of the University in population as well as physical size makes it difficult to reduce emissions while providing the same level of service.

Normalizing on-site emissions by square foot building space at U-M AA provides the information detailed in METRIC 3. From 1990 to 2001, available building space increased 22% (area totals available in introduction). During the same time period, total on-site GHG emissions per square foot increased 1.1% from 17.7-kilograms/square foot to 17.8-kilograms/square foot. For electricity and heating/cooling only, on-site GHG have increased slightly from 17.13-kilograms/square foot to 17.57-kilograms/square foot. The data indicates that the energy intensity of the campus, in terms of building area, has remained nearly the same for the period studied. In this case, energy intensity can be defined as the amount of energy required for each square foot of building space.

In addition to worldwide tracking of greenhouse gases, six criteria pollutants are monitored by the US Environmental Protection Agency. These include carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM), and lead (Pb). All can have negative effects on human health. Carbon monoxide is a colorless gas, which can enter the bloodstream through the lungs and can reduce the delivery of oxygen to the body's organs. Sulfur dioxide and nitrogen dioxide are emitted when fossil fuels are burned and also in other industrial processes. They can cause breathing difficulties in humans. SO_2 and NO_2 also cause acid rain, which negatively impacts aquatic and terrestrial ecosystems, and erodes buildings and statues. Particulate matter is the term used to describe small solid or liquid particles released into the atmosphere. Sources are dust from roads, soot from burning wood, and industrial processes including the burning of fossil fuels. PM can cause respiratory problems. Lead can cause very serious neurological disorders and mental retardation.

Criteria pollutant emissions measured in INDICATOR 13 include carbon monoxide, lead, nitrogen dioxide, particulate matter, and sulfur dioxide. Nitrogen dioxide emissions make up the largest portion of on-site criteria pollutant emissions (78.6% in 2001). The majority of emissions result from the burning of fuel oil and natural gas. Both NO_2 and CO, the two largest contributors to criteria emissions by mass emitted, were lower in 2001 than in 1990. NO_2 emissions have decreased from 637 metric tons to 591 metric tons, while CO

METRIC 3 ON-SITE GHG EMISSIONS PER SQUARE FOOT BUILDING SPACE (INCLUDES CO_2, NO_2, CH_4)



emission levels have gone from 106 metric tons to 98 metric tons. Much of this can be traced back to increased reliance on the newer turbines at CPP, which have lower emission factors per unit of fuel consumed then their older counterparts. The spike in sulfur dioxide emission in 1997 is attributed to the increased use of fuel oil at the power plants for that year. Natural gas price fluctuation made it more economically sensible to utilize fuel oil over natural gas during that time period.

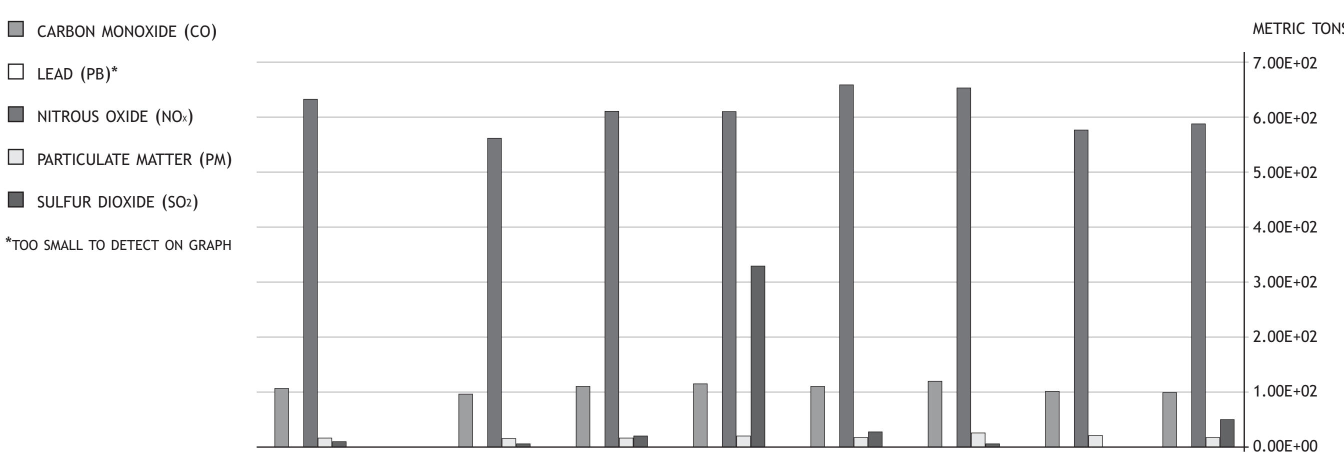
In addition to GHG's and criteria pollutants, there exist other by-products of human activities in the form of pollution emissions. Information for emissions of toxic and carcinogenic substances, INDICATOR 14, was not available for this report.

There are many difficulties associated with collecting data for this indicator. Technologies associated with emission measuring devices dictate that identification of the substances to be measured must be made before installation. Research that involves the use of some of these substances is extremely varied, and involves numerous types of chemicals. As a result, it is difficult to assess in any given year which substances, if any, should be measured and reported. The importance of the research that may be producing these

Indicator 14 Emissions of Toxic and Carcinogenic Substances to Air

DATA NOT CURRENTLY TRACKED
(RECOMMENDED FOR INCLUSION IN FUTURE ASSESSMENTS)

Indicator 13 On-site Emissions of Criteria Pollutants (Electricity and Heating/Cooling Only)



Indicator 15 Available Effluent Data for FY 2001

	IN CUU (100 CUBIC FEET)	IN GALLONS	IN GALLONS/DAY	IN GALLONS/CAPITA/DAY[xvi]
TOTAL FOR SANITARY	1,398,511	1,046,226,079	2,866,373	46
TOTAL FOR COOLING AND IRRIGATION	234,957	175,771,332	481,565	8

emissions cannot be discounted and make it difficult to call for abolition of these types of emissions without considering the benefits of the research.

2.7 Effluents Category

Indicator 15

Available effluent data for fiscal year 2001

An attempt was made to gather data on the total effluents directly discharged to receiving water by U-M AA, which is INDICATOR 15. Receiving water is the body of water into which the wastewater is released, and effluent refers to wastewater of any type. Effluents may contain pollutants, such as mercury, phosphates or nitrates, which may originate from other sources and deposit from the air into storm water. The receiving water in this case is the Huron River, which is approximately 125 miles long and flows into Lake Erie. The Huron River watershed is 908 square miles (581,120 acres).

Effluent guidelines are national standards for wastewater discharges to surface waters and to municipal sewage treatment plants. Effluent guidelines are derived from Title III of the Clean Water Act. It is vital to consider the fate of water used by U-M AA in assessing the sustainability of the campus. Water at U-M AA may be channeled to sanitary sewers after use; it may be channeled to storm sewers; and it may be used to water lawn and playing fields (irrigation). Any water that leaves the U-M AA campus in sanitary sewers flows to the City of Ann Arbor Wastewater Treatment Plant. Water used in cooling towers at the Central Power Plant is considered non-contaminated water. This water is treated with ozone before it is used at the plant. After use, it enters storm sewers and flows directly into the Huron River without the need for treatment.

The University of Michigan and the City of Ann Arbor have legal mandates to care for storm water runoff. Ann Arbor is one of five Michigan cities that have been granted a PHASE I municipal storm water permit by the state to regulate storm water flows to minimize pollution. The University of Michigan is also the only non-city that has been granted a PHASE I municipal storm water permit by the state.[xxiii] It maintains its own storm water system, which has 48 discharge locations that empty into the City of Ann Arbor storm system, Allen Drain, Traver Creek, Miller's Creek and the Huron River.[xxiv] The U-M AA is currently integrating a retention basin that could hold 1 million gallons of storm water into a new constriction. Water that is used to water lawns (irrigation) mostly infiltrates into the soil and, therefore it is not considered in this indicator.[xxv]

The target information was total effluents discharged to receiving water. This is equivalent to sanitary water and cooling water. However, the data needed did not match the data available. U-M AA keeps water data records in two categories. The first category is sanitary, and the second category is cooling water and irrigation water. Thus, because of data gathering practices, it is not possible presently to report total effluents directly discharged to receiving waters. Because the only available data were for 2001, it is not possible to do trend analysis, or to determine whether this indicator is changing over time. In an effort to operate more sustainably, U-M AA has taken steps to reduce the amount of effluent it generates. It regularly monitors water leaving its buildings and the storm water, as required by regulation.

2.8 Solid Waste

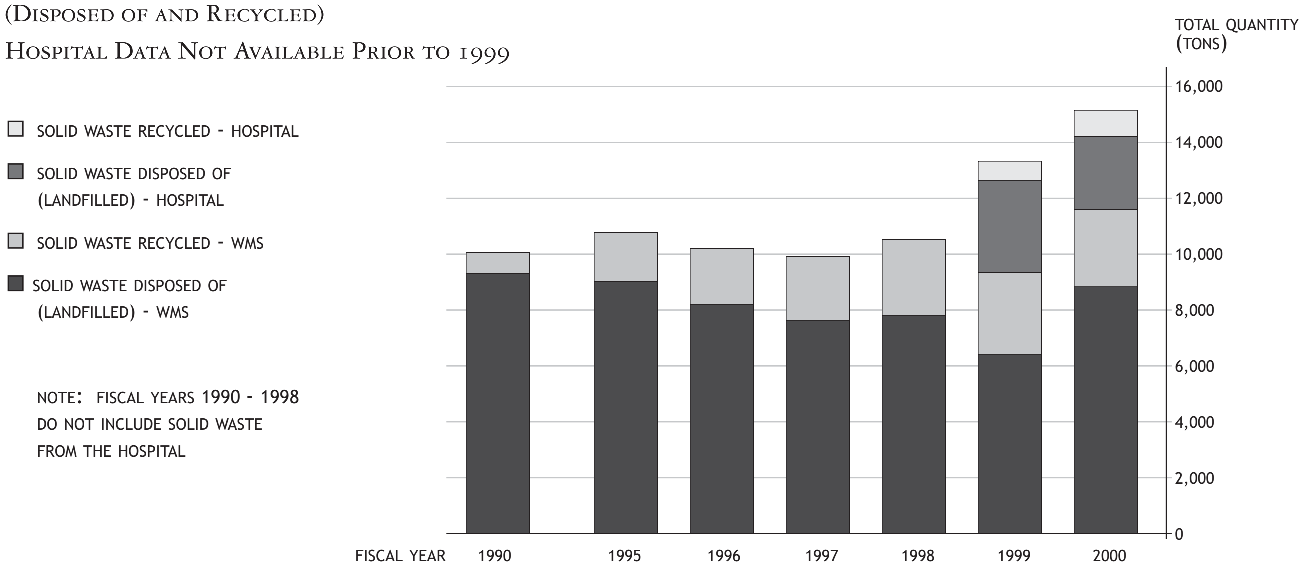
Indicator 16

Total solid waste generated (disposed of and recycled) – hospital data not available prior to 1999

The generation and disposal of solid waste, defined by the US EPA as municipal solid waste, poses two types of challenges to sustainability. First, waste generation is often accompanied by the consumption of new resources that are used to replace those disposed of. Second, landfills consume land area. Both of these environmental impacts also have economic counterparts – the consumption of new materials designed to replace those discarded, and the shipment of wastes to landfill, require outlays of financial capital. While the Michigan Department of Environmental Quality estimates that the state of Michigan has 15-17 years of landfill disposal capacity available at current rates of landfilling, imports of waste from other areas are increasing, causing concern among Michigan representatives.

U-M Grounds and Waste Management Services (here after WMS) manages recycling and non-hazardous waste collection services for all academic and residence hall buildings on the U-M AA campus. U-M Health System (UMHS) Waste Management and Recycling manages recycling and non-hazardous waste collection for the three hospitals at U-M AA. Most of the U-M AA's non-recycled waste (solid waste disposed of) is ultimately landfilled at Arbor Hills Landfill, although some U-M AA hospital waste is taken to Salt Trails Landfill.

Indicator 16 Total Solid Waste Generated (Disposed of and Recycled) Hospital Data Not Available Prior to 1999



Indicator 16 reports the amount of solid waste generated within the U-M AA system, showing the proportion of generated waste that is recycled and the proportion that is disposed of in a landfill. Recycling and non-hazardous waste collection for the hospital system is managed independently from collection from all academic and residence hall buildings on the U-M AA campus. Because historical waste management data were only available from the hospital beginning in 1999, and because the hospital is required by state reporting guidelines to report results in calendar years rather than fiscal years, results from the hospital system are distinguished from all other data.

The total amount of Solid Waste generated by the U-M AA system (excluding the hospital) has remained relatively constant at approximately 10,000 tons per year over the past ten years. The total quantity of solid waste that is recycled has generally been increasing over the past ten years, with the only exception being a very slight (approximately 2%) decrease from a ten-year high of 3,609 tons recycled in FY 1999 to 3,531 tons recycled in FY 2000. The proportion of total solid waste generated that is recycled by the U-M AA has increased over the past ten years from 7.4% in FY 1990 to approximately 23% in FY 2000. Calculations for this indicator do not include materials recovered in some of the U-M AA's most recent recycling initiatives, including the recycling of fluorescent light tubes and the resale of used equipment at Property Disposition. The drop in recycling in FY 2000 could be due to an increase in the disposal (rather than recycling) of recyclable materials (which would cause a corresponding increase in the quantity of solid waste disposed of) or a decrease in the use of materials that could be recycled. Of the total quantity of materials recycled, the categories of paper and cardboard, mixed containers, and pallets and wood together represent over 97%. Paper and cardboard recycling alone has made up over 88% of the total quantity of materials recycled every year since 1995.

2.9 Hazardous Waste

Indicator 17

Hazardous waste generation 1999

Indicator 17 presents total hazardous waste generated, as defined by the United States Environmental Protection Agency (EPA). The data is separated into Identification Zones (EPA ID zones). It is important to examine this indicator because the generation of hazardous wastes and the use of hazardous materials have the potential to adversely impact environmental and human health. The activities that are part of U-M AA's regular operation, and can potentially generate hazardous wastes include the following: paint and solvent use; hospital and laboratory operation; vehicle maintenance; pesticide use; and printing. Good hazardous waste management includes using and reusing materials as much as possible. The data source is the University of Michigan's 1999 Hazardous Waste Biennial Report, which tracks hazardous wastes leaving the campus in a solid or liquid form. The EPA categorizes hazardous wastes into different codes, according to their chemical characteristics. The grand total of hazardous wastes, including all EPA codes and ID zones has been determined; the metrics are calculated based on the total of hazardous wastes.

The predominant origin of hazardous waste at U-M AA is research and teaching laboratories. A trend analysis could illustrate the change of hazardous waste generation at U-M AA in relation to the growth in general and student population, building square footage, and research expenditures throughout the last decade. This analysis was impeded for this report by the format in which the data is stored, and by time constraints.

Indicator 17 Hazardous Waste Generation 1999

IN LBS PER CAPITA	IN LBS PER STUDENT	IN LBS PER RESEARCH DOLLAR	IN LBS PER SQ. FT. BLDG. SPACE
5.54	9.10	0.0007	0.001

SOCIAL INDICATORS

3.1 Quality of Management

Indicator 18

Evidence of student/employee orientation to organizational vision

Indicator 19

Evidence of student/employee engagement in shaping management decision making

Indicator 20

Ranking of the organization as an employer in internal and external surveys

U-M AA occupies a unique position along with other universities in its role as both an educator and an employer. The two areas are strongly interconnected; the performance of the University as an academic institution is invariably influenced by who the University employs and how satisfied these employees (faculty and staff) are in their jobs. Conversely, the attractiveness of the University as an employer is influenced by the schools academic reputation. University performance in both teaching and employment is invariably measured through the use of surveys and polls. Each year, hundreds of results are published from varying sources. The variation in results makes it difficult to assess actual performance. Periodic reviews and feedback from stakeholders should be incorporated on a regular basis to ensure that the indicators continue to represent the perceived performance of the University.

The University should reach consensus on which polls best characterize management performance and synthesize the results of these surveys for clear communication to the greater community. In addition, present data on retention rates and employee satisfaction, which are currently available, should be included with the communication to provide additional information.

Indicator 18 Evidence of Student/Employee Orientation to Organizational Vision

DATA TO BE DETERMINED

Indicator 19 Evidence of Student/Employee Engagement in Shaping Management Decision Making

DATA TO BE DETERMINED

Indicator 20 Ranking of the Organization as an Employer in Internal and External Surveys

DATA TO BE DETERMINED

3.2 Community Development

Indicator 21

Student contributions to community development

Indicator 22

Faculty and staff contributions to community development

Like businesses and other organizations, universities depend upon the social and economic health of, and services provided by, the local, regional, and national communities in which they operate. Universities help to ensure the continued availability of these community resources over time by contributing positively to their development. This contribution can be in the form of employment (see SECTION 3.3) or donation of time, services, and/or funds to local communities or not-for-profit organizations. INDICATOR 21 examines such donations on the part of students, while INDICATOR 22 looks at contributions by faculty and staff. These indicators do not provide a sure sign that initiatives are having the desired effect. A more accurate analysis of the success of U-M AA's community development initiatives would involve gauging the perceptions of the community directly through surveys or community advisory panels, techniques that were beyond the scope of this initial assessment. Instead, an increase in the level of donations over time is used as a proxy for an increase in U-M AA's community development capacity and, hence, its overall sustainability.

Community development activities take place in a wide variety of areas across the U-M AA system. These activities can range from once-a-year food and clothing drives to monthly payroll

Indicator 21 Student Contributions to Community Development
Sampling of Student-led Community Development Organizations

ORGANIZATION	KEY ACTIVITIES	MEMBERSHIP/ PARTICIPATION	HOURS OF SERVICE	$ RAISED
DANCE MARATHON	Raises funds for pediatric rehabilitation programs	300	unknown	unknown
CIRCLE K	Members volunteer service at approximately 150 different projects each year	150	5,000	unknown
DETROIT PROJECT, THE	Sponsors ongoing projects and large-scale day of service each spring	1,300	unknown	unknown
K-GRAMS	Mentoring and learning program that pairs college and elementary students	1,500	unknown	unknown
ALTERNATIVE SPRING BREAK	Begun in 1990, ASB is a week-long immersive living and working experience offering opportunities for students to volunteer for community service related to social issues	325	53,300	unknown
ALTERNATIVE WEEKENDS	AW volunteers visit sites once a month to perform community service and build relationships with sites	100	13,000	unknown
VOLUNTEERS INVOLVED EVERY WEEK	Links small groups of students with an area agency for weekly service throughout a semester	140	12,600	unknown
SERVICE PROMOTING AWARENESS REFLECTION AND KNOWLEDGE (SPARK)	One-day service events designed to spark interest in longer commitments	1,300	7,800	unknown
GALENS MEDICAL SOCIETY	Sponsors Galens Tag Days to raise money for projects aiding sick and needy children	unknown	unknown	$50,000
TOTALS		AT LEAST 5,115	AT LEAST 91,700	AT LEAST $50,000

deduction programs and services made available by the U-M AA to the broader community. No single entity within the U-M oversees all of these diverse community development activities, but a sense of scale can be established by assembling information from a variety of sources. There were a total of 183 student community service organizations listed in the Maize Pages directory in January 2002 ranging from small to large and from issue-oriented groups to groups focused on a single event during the academic year. Some of the largest (in terms of membership and/or participation) are outlined in Indicator 21.

In 2001, the Community Service Commission (one of two funding bodies within the Michigan Student Assembly) allocated approximately $75,000 of the funds raised annually through a student-imposed $1 tuition surcharge to approximately 75 groups per semester. No historical data were available for past donation rates.

In addition, students participate in such U-M AA-sponsored programs as "Student Move-Out," where departing students are encouraged to contribute clothing, shoes, food, toiletries, and household items to donation bins then transferred by U-M AA to local agencies.

Community development efforts undertaken by faculty and staff provide the remainder of the U-M AA's total community development contribution. As of January 2002, the Community Assistance Directory maintained by the U-M AA listed 354 faculty and/or staff-sponsored community assistance projects. At present, the U-M AA does not collect information regarding the combined magnitude of all of these projects (in terms of people served, dollar value of services donated, numbers of faculty and staff involved, or another measure). However, expenditures associated with a portion of them are captured in the "Public Service" expenditures line item in the U-M AA's Financial Reports. INDICATOR 22 presents U-M AA faculty and staff participation in and donations to the United Way payroll deduction campaign, together with U-M AA "Public Service" expenditures.

Although much smaller than "Public Service" expenditures, faculty and staff contributions to the United Way Campaign have generally been rising over the past five years, but participation rates in the program have been falling. This is a trend that has been steady over the longer-term past – in 1990, participation rates were 47.6% for the United Way payroll deduction campaign. The continued drop in participation rates may not be a signal of program ineffectiveness but rather of the proliferation of options for community service now available to faculty and staff. Several years ago, the United Way campaign represented one of a more limited number of community service opportunities. Today, however, faculty and staff have a wider variety of community service options from which to choose. With the exception of fiscal years 1997 and 1998, expenditures related to "public service" have been increasing over the past ten years. However, without knowing more about how expenditures within this category have varied, it is impossible to define the reasons for these changes.

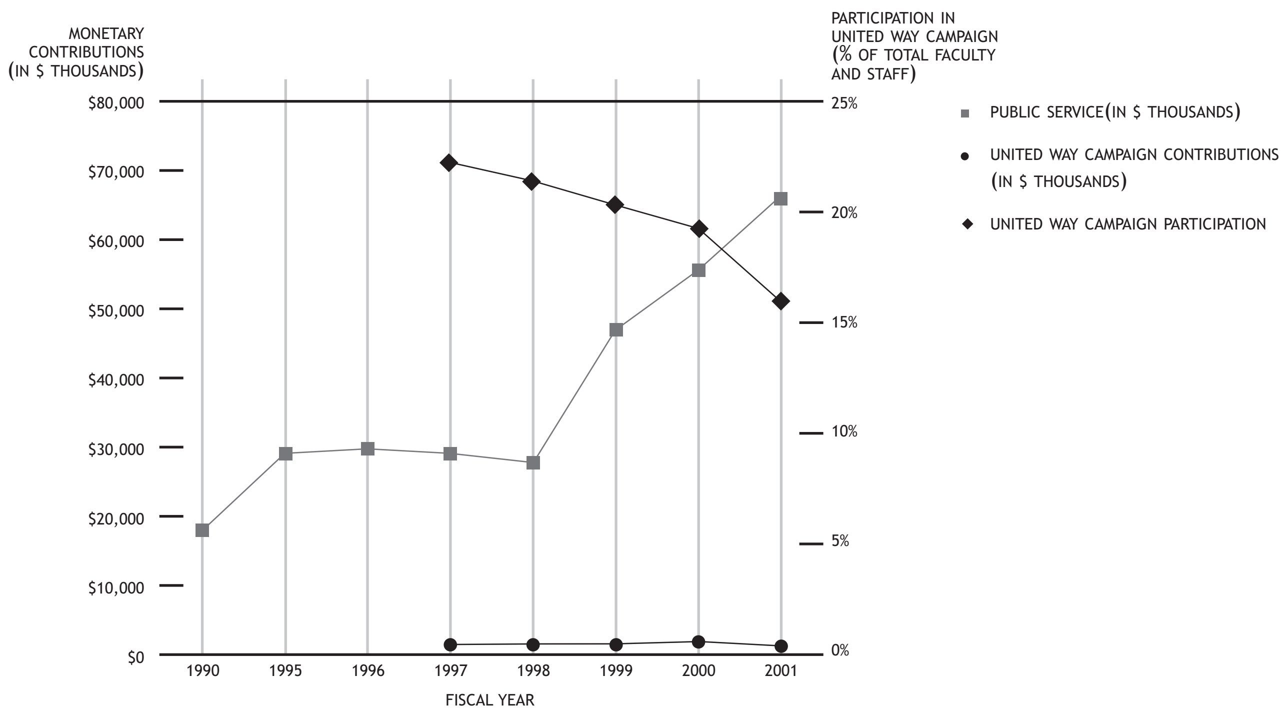
3.3 Wages and Benefits Category

Indicator 23

Wage distribution at U-M AA, in 2001 $

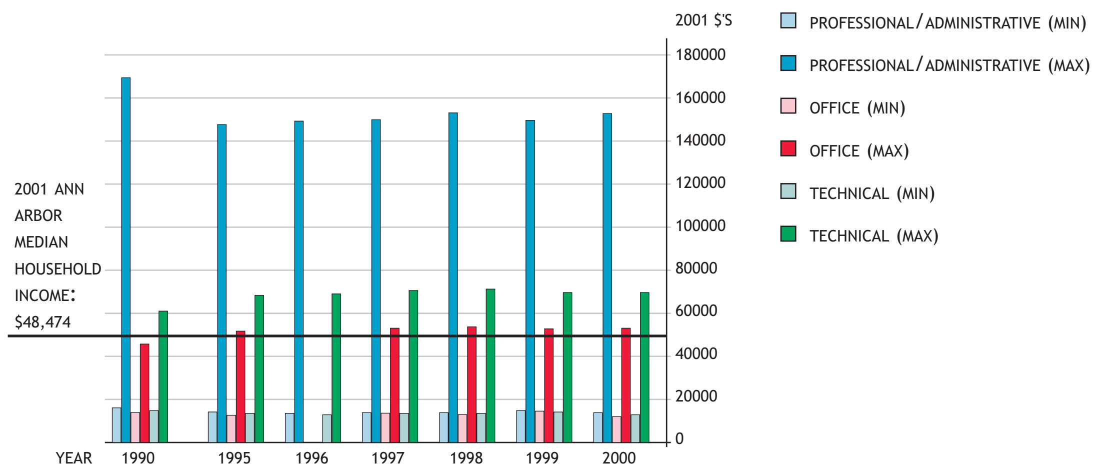
Wage distribution at U-M AA was examined in an effort to understand the allocation of financial resources to faculty and staff. It is important to assess salaries in order to understand compensation at U-M AA. Employees compose one of the most

INDICATOR 22 FACULTY AND STAFF CONTRIBUTIONS TO COMMUNITY DEVELOPMENT

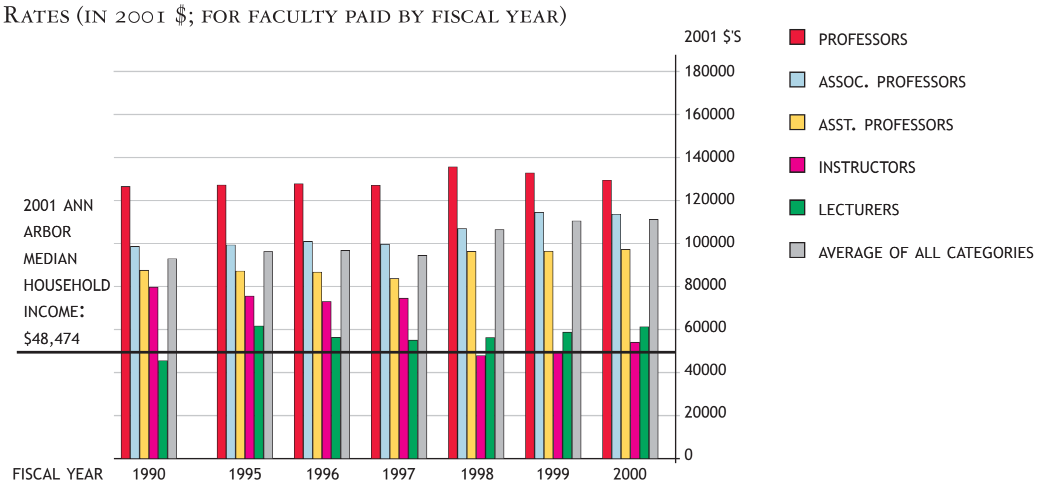


important groups of stakeholders for U-M AA. To maintain U-M AA's reputation as one of the most respected institutions of higher education in the country, it must hire talented, qualified and committed faculty and staff. It must determine wage rates that attract and retain employees, but still allow the U-M AA to meet operating budgets. If the difference between the most highly paid employees and the least highly paid employees is significant, or the distribution of wage categories is very unbalanced, it may be a sign of inequity. INDICATOR 23 shows wage distribution in 2001 dollars. The wage information in each year's dollars was converted into constant 2001 dollars,

INDICATOR 23A WAGE DISTRIBUTION AT U-M AA, IN 2001 $



INDICATOR 23B FACULTY MEDIAN FULLTIME SALARY RATES (IN 2001 $; FOR FACULTY PAID BY FISCAL YEAR)



using information from the Consumer Price Index. INDICATOR 23A shows Professional/Administrative, Office and Technical salaries. The Professional/Administrative category is defined as employees who have at least a bachelor's degree. The Office category is defined as secretarial or clerical. The Technical category is defined as employees who have acquired two years of education after high school. Maximums and minimums are displayed on the graph. Salaries appear to be holding steady over time. The 2000 median household income in Congressional District 13 of Michigan, of which Ann Arbor is a part of, is $48,474, according to the US Census Bureau.[xxvii]

INDICATOR 23B displays faculty median full-time salary rates (in 2001 $; for faculty paid by fiscal year). Faculty members are being paid competitively as compared to median household income. Professor salaries have remained steady, Associate Professor and Assistant Professor salaries have increased since 1997, while Instructor salaries have fallen and Lecturer salaries have remained steady. The average of all categories has showed an increasing trend over time.

3.4 Health & Safety

Indicator 24

Number of injuries to U-M AA employees while working reported per year

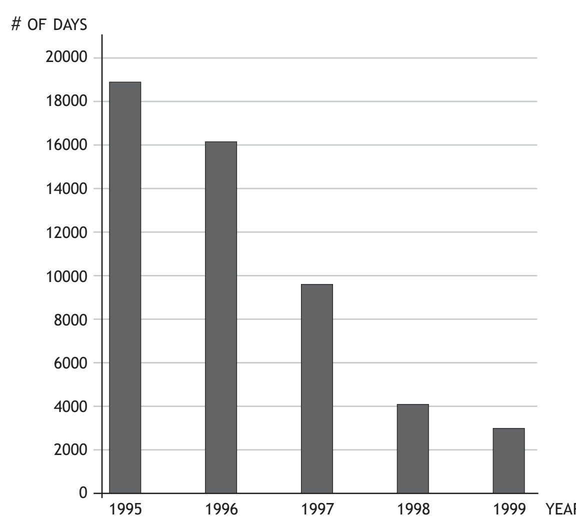
Indicator 25

Number of crimes reported to U-M AA Department of Public Safety (DPS) by violation type

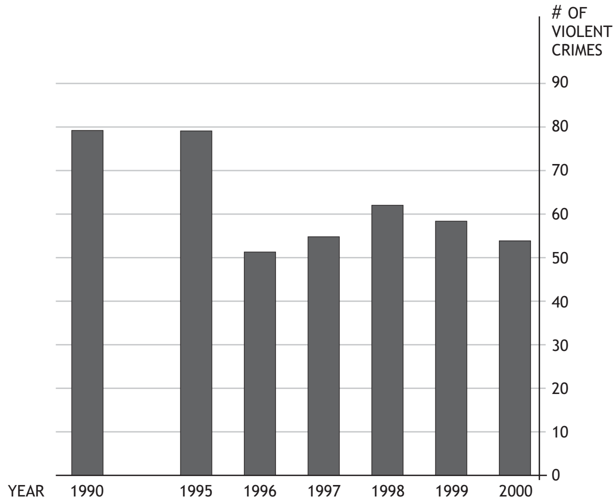
It is important to know the number of injuries which occur at U-M AA each year to evaluate U-M AA's employee safety record. The prevention of injuries also saves U-M AA money because it thereby need not pay lost wages, medical bills or lawsuits. The number of days lost by employees due to injury per fiscal year is displayed in INDICATOR 24, and shows a decreasing trend over the period studied.

By analyzing the amount of crime on campus, it is possible to determine the safety and comfort level of students, faculty and staff on campus. The number of crimes reported to U-M AA Department of Public Safety (DPS) by violation type is examined in INDICATOR 24. The graph displays the number of violent crimes reported per calendar year. Violent crimes are defined to include murder and non-negligent manslaughter, negligent manslaughter, forcible rape, forcible sodomy, sexual assault with an object, forcible fondling, incest, statutory rape, robbery, aggravated assault and arson. Overall, the data show that violent crimes on campus are decreasing over time.

Indicator 24 Number of Injuries to U-M AA Employees While Working Reported Per Fiscal Year



Indicator 25 Number of Crimes Reported to U-M AA Department of Public Safety (DPS) by Violation Type



Indicator 26 Ratio of Budget Assigned for Training to Annual U-M AA Operating Costs

DATA NOT CURRENTLY TRACKED
(RECOMMENDED FOR INCLUSION IN FUTURE ASSESSMENTS)

Indicator 27 Number of Legal Actions Related to Antiunion Practices by Type

DATA NOT CURRENTLY TRACKED
(RECOMMENDED FOR INCLUSION IN FUTURE ASSESSMENTS)

3.5 Training for Faculty and Staff

Indicator 26

Ratio of budget assigned for training to annual U-M AA operating costs

The university employs and trains a diverse set of faculty, administrative and supporting staff, and students. It is in the university's interest to provide the necessary training that these employees need to perform well in their jobs. The ratio of budget assigned to training to operational costs gives an idea of the priority the UM-AA places on faculty and staff development.

3.6 Freedom of Association

Indicator 27

Number of legal actions related to antiunion practices by type

Freedom of association is a constitutional right that emanates from the First Amendment of the Constitution of the United States of America and the Freedom of Speech. The selection of INDICATOR 27 is supported by Prof. Thomas N. Gladwin's definition of the social component of sustainability. He has defined it as: "that relating to civil society, social cohesion, trust, reciprocity norms, equity, empowerment, freedom of association, orderliness and so forth that facilitate co-ordination and co-operation for mutual benefit." [xxviii] Therefore, a "truly sustainable society is one that organizes its economy to ensure the maintenance of its stocks of ecological, material, human and social capital, thus adhering to that prudent ancient wisdom of 'not eating thy seed corn.'" [xxix] Association within an educational institution may happen for several reasons, such as collective bargaining (among supporting staff), and common interests or beliefs, common history or descent, among all staff, faculty and students. Observance of the right of freedom of association involves the UM-AA's administration permitting the formation of unions and associations, recognizing their existence, facilitating meeting locations and *"a truly sustainable society is one that organizes its economy to ensure the maintenance of its stocks of ecological, material, human and social capital, thus adhering to that prudent ancient wisdom of 'not eating thy seed corn.'"*

Prof. Thomas N. Gladwin

flexibility in time, fair and equal respect to the organizational leaders, within the bounds of the law. This definition can be extended as far as the University relates to external entities such as suppliers whose activities may have a high damage or benefit potential to the UM-AA's reputation.

3.7 Non-discrimination

Indicator 28
Percentage of women and ethnicities in faculty tenured or tenure-track positions

Indicator 29
Total U-M AA student enrollment by gender and ethnicity/citizenship

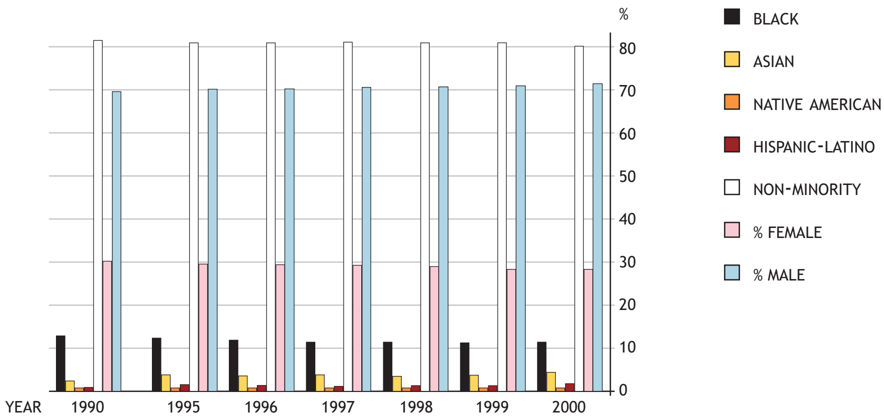
Indicator 30
Graduation rates by gender and ethnicity

Indicator 31
Undergraduate and graduate tuition costs vs equality of access to financial aid

The U-M has declared in various arenas its non-discrimination policy and the value its sees in diversity as a higher-level educational institution.[xxx] Diversity, for a university, could be defined as differential experiences represented in all sectors comprising in its population.[xxxi] Non-discrimination would entail consideration towards diversity when making decisions. In order to move toward social sustainability in these areas, the university "must work diligently to create a welcoming community, encouraging respect for diversity in all of the characteristics that can be used to describe humans: age, race, gender, disability, ethnicity, nationality, religious belief, sexual orientation, political beliefs, economic background, and geographical background."[xxxii] In order to properly address these social issues, not only does the university need to evaluate its non-discriminatory policies and/or affirmative action policies, when hiring employees or admitting students, but also needs to examine the daily working and learning environments and the support that it provides to all sectors of its population.[xxxiii] This is also reflected often in its population retention rates. Indicator 28 illustrates diversity, as measured for tenured and tenure-track faculty.

The faculty tenure and tenure-track faculty gender population at U-M AA is predominantly male. This distribution has remained practically constant between 1990-2000, with a 1.9% net decrease of females. The ethnic composition of the tenured and tenure-track faculty population is predominantly non-minority. Between 1990 and 2000, there was a net increase in minority professors of 6.9%. This increase is not equally distributed among the categories defined by the University but is due predominantly to Asian and Black with a smaller representation of Hispanic-Latino/a professors. In contrast with the gender distribution of the faculty population previously discussed, there is a clear female predominance in the staff population. During the 1990-2000 decade, the net change in distribution was 1.9% of male increase and female decrease. The ethnic composition of U-M AA's staff has changed even less dramatically than the gender composition over time. Non-minority people compose it predominantly,

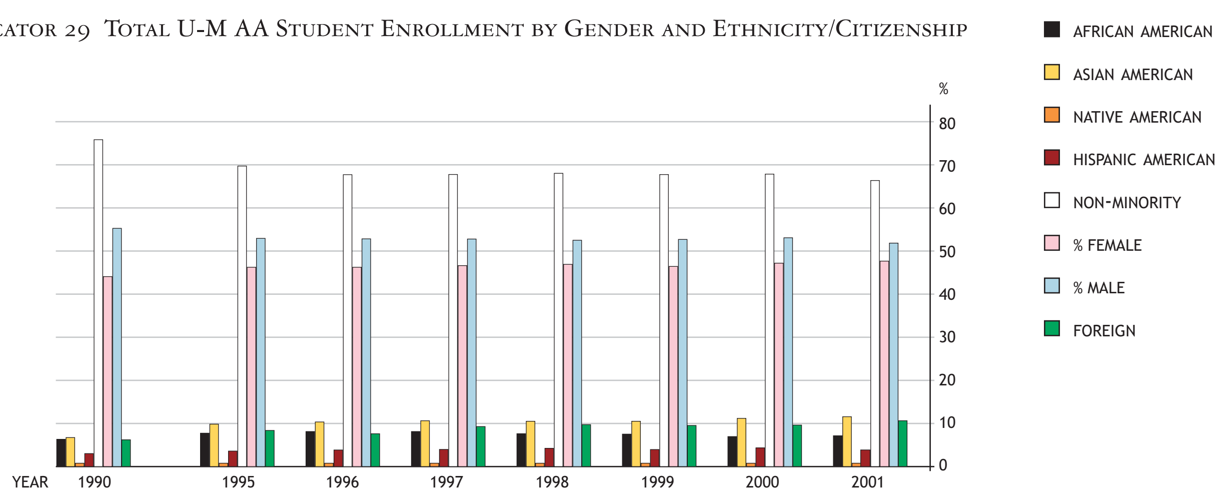
INDICATOR 28 PERCENTAGE OF WOMEN AND ETHNICITIES IN FACULTY TENURED OR TENURE-TRACK POSITIONS



with less than the 20% comprised by minorities. The non-minority population has decreased by a net 1.3% during the 1990-2000 decade, which implies such an increase in the minority population. Among the minority groups, the Black sector is the largest, oscillating between 13.5% and 11.9%. It has decreased by a net 1.6%. The Asian population, however, has increased by a net 1.7% during that period. The Hispanic-Latino/a population, in contrast, has increased by 0.7%, while the Native American increased by 0.2%.

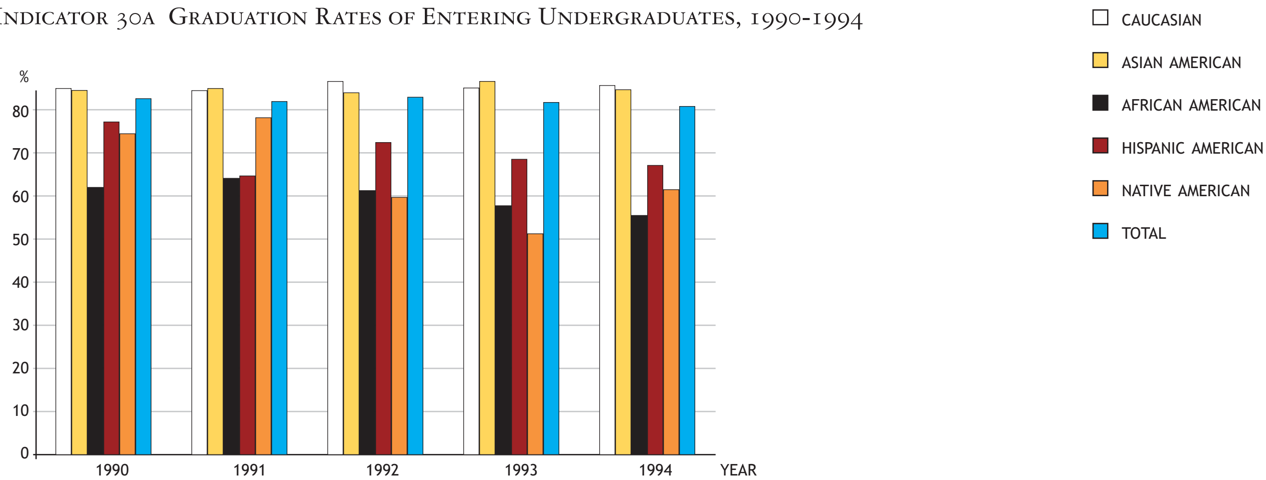
During the 1990-2001 period, the total student gender composition changed with the percentage of females becoming much closer to that of males. The percentage of non-minority students has decreased during this period, while that of Asian Americans and foreign students have seen the highest increases. INDICATOR 30 presents the percentages of undergraduate students, by ethnicity that graduated by their sixth year, grouped by their freshman cohort or the year when they first enrolled in U-M AA.

INDICATOR 29 TOTAL U-M AA STUDENT ENROLLMENT BY GENDER AND ETHNICITY/CITIZENSHIP

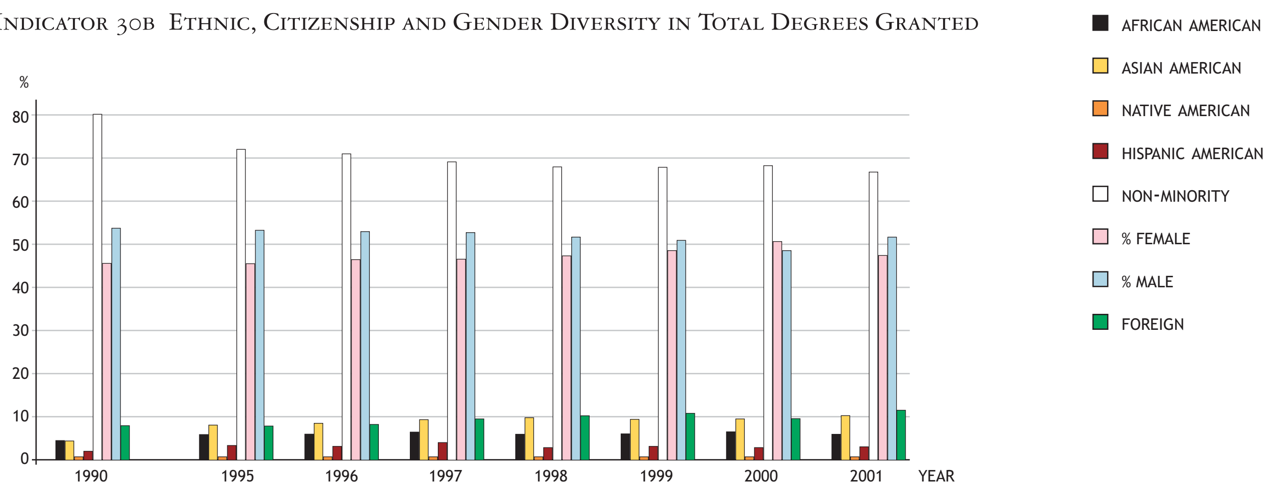


Indicator 30 Graduation Rates by Gender and Ethnicity

Indicator 30a Graduation Rates of Entering Undergraduates, 1990-1994



Indicator 30b Ethnic, Citizenship and Gender Diversity in Total Degrees Granted



Among the different ethnicities of undergraduate students, Asian Americans and Caucasians have the highest graduation rates. Both are higher than the average for U-M AA undergraduate students. The rest of the ethnic groups have graduation rates below the average. In the cohorts of students that began their undergraduate degrees between 1990 and 1994, graduation rates of Caucasian and Asian American students have been between 85-87%, which is higher and closer to the graduation rate for the total population (which has been either 82% or 83% during this period) than the other ethnic groups. In general, when comparing the graduation rates of these cohorts for Asian and Caucasian Americans that have risen by 0.2% and 0.6%, respectively, the other groups have experienced net decreases. Graduation rates for African Americans had a 5.9% decrease, while those of Hispanics and Native Americans had a 9.8% and 13.5% decline, respectively.

When looking at the total degrees granted by the University (including graduate and undergraduate degrees), the percentage of non-minority students is generally higher than the enrollment of students in this group.

U-M has been a pioneer in many of its efforts to overcome discrimination and become more inclusive and diverse. This is evident in all the initiatives that are currently in progress and the variety of resources available. In the gender statistics, there is clearly a predominance of males in the faculty, graduate student body and first professional degree body. On the other hand, females outnumber males in the staff and in the undergraduate student body. At some degree in all categories, the number of women is rising. We cannot reach conclusions in relation to the proportion of women in the senior executive and administrative positions at U-M AA because the available information was only for one year. When compared to national and Michigan state's population gender composition for 2000, the U-M falls short in many of the sub-indicators examined but is above many others. In the United States, females comprise 50.9% of the population and men 49.1%, while in Michigan, males comprise 49% and females 51%. Within the categories examined, the one that most closely resembles the national and state averages are the undergraduate student population. The staff category is the only one in which females outnumber males substantially. Nationally, males holding PhD's in the United States are 70.5% and women are 29.5% of the total holders. Of all Master's degree holders, 49.4% are males and 50.6% females. Approximately 67.4% of first professional degree holders are males, while 32.6% are women. Although the 2000 Population Census collected data on degrees or level of educational attainment by gender and ethnicities, this was the first year in which data is collected this way. In previous occasions, data were collected for highest level reached and did not specify whether at the graduate level it was Master's, Professional or Doctorate degrees. Hence a historical trend analysis of the population census data cannot be conducted on this issue.[xxxiv]

In all of the categories examined non-minority students attending U-M AA outnumber the rest of the ethnic and nationality classifications. This has been true for students at all levels in the period of time that this project examines. The number of minority and foreign students at all level has been increasing at different rates, with a correlated decrease in non-minority students. This change might be a result of more access to better education for these groups but it may also be a result of the affirmative action policy adopted by U-M in the past years. The average national ethnic composition of the total population is[xxxv]: 75.1% White, 12.3% African American, 12.5% Hispanic[xxxvi], 0.9% Asian[xxxvii] and American Indian or Alaskan Native 0.9%. The Michigan averages are: 80.2%, 14.2%, 3.3%, 1.8% and 0.6%. In terms of PhD's 81.6% are held by Whites, while 3.5%, 10.2% and 4.1% are held by African Americans, Asian and Hispanics, respectively.[xxxviii] These numbers at U-M AA in the different categories are not representative of the national or the state population composition.[xxxix] In some categories some groups are more represented, while in others they are underrepresented. However, we cannot qualify this as positive or negative. It is important that the University establishes its goals in this regard in relation to its goals at each level of its functioning. U-M AA also is a dynamic system whose population is changing and which has the ability to contribute to changes at the other scales as it prepares students at all levels and employs different men and women at all levels. Setting goals in relation to diversity is an intricate issue that involves judgments of how the mission of the University can be best met in this regard.

The graduation rate is higher and rather similar for Caucasians and Asian Americans and lower for African American, Hispanics and Native Americans. This report did not examine how many of the students who did not graduate within a

Indicator 31 Undergraduate and Graduate Tuition Costs vs Equality of Access to Financial Aid

DATA NOT CURRENTLY TRACKED
(RECOMMENDED FOR INCLUSION IN FUTURE ASSESSMENTS)

six-year period from their initial enrollment left U-M AA, and how many completed their degrees later. There are many factors that could potentially affect each individual's experience at U-M AA. It is important that U-M AA optimize these experiences as part of the on-going effort to fulfill its mission.

3.8 Sustainability in Education

Indicator 32

Percent of undergraduate and graduate classes that address sustainability issues

Indicator 33

Sustainability in curriculum and research

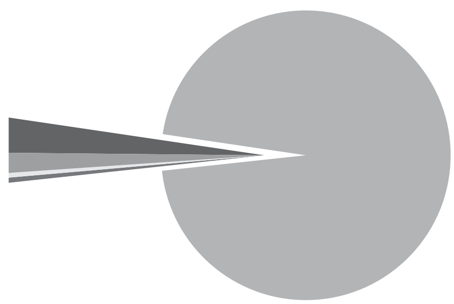
The U-M AA can make one of its most significant and lasting contributions to its own and global sustainability by ensuring that the education and research it produces address sustainability issues. Through its educational curriculum and its research, the U-M AA has a sizable impact on the knowledge available to the world's future leaders, and thus a significant opportunity to ensure that those leaders are equipped with the most accurate understanding of critical sustainability issues and solutions possible. Full commitment to sustainability requires that the U-M AA ensure not only that its operations are carried out in a sustainable way, but also that the services that those operations support have a positive impact on global sustainability.

The U-M AA's formal educational curriculum consists of the courses offered to students each semester and the degree requirements set forth by the U-M AA. However, education also occurs through many student- and University-initiated forums outside the classroom, including student government, clubs, service organizations, lecture series, conferences, and other extracurricular activities, as well as through campaigns and programs organized by the Housing, Dining Services, the Residential College, and other entities on campus. In addition, universities educate students via a "latent curriculum", or the examples they set in their own internal operations. The U-M AA's extracurricular and latent curricula are fundamental parts of students' education. The Michigan Student Assembly recently passed a resolution urging the U-M AA to establish and implement sustainability goals and initiatives, providing one indication that the topic of sustainability is considered within the extracurricular curriculum. However, time constraints forced this report to be limited to an analysis of the U-M AA's formal curriculum, and its research portfolio, only.

Indicator 32 reports the number of classes that incorporate sustainability topics, allowing the U-M AA to assess the degree to which these concepts are being integrated into the curriculum. Data for this indicator were drawn from a study conducted by researchers at the U-M AA's Center for Sustainable Systems.[XL] The study classified a list of environmental undergraduate and graduate courses identified by an LS&A curriculum development committee according to each course's coverage of sustainability topics. Classification criteria were drawn from the National Wildlife Federation's 2001 *State of the Campus Environment* survey.

Of the 6,541 courses offered in Fall 2000 and Winter 2001, approximately 4.6% (or 300 courses) addressed sustainability

Indicator 32 Percent of Undergraduate and Graduate Classes That Address Sustainability Issues



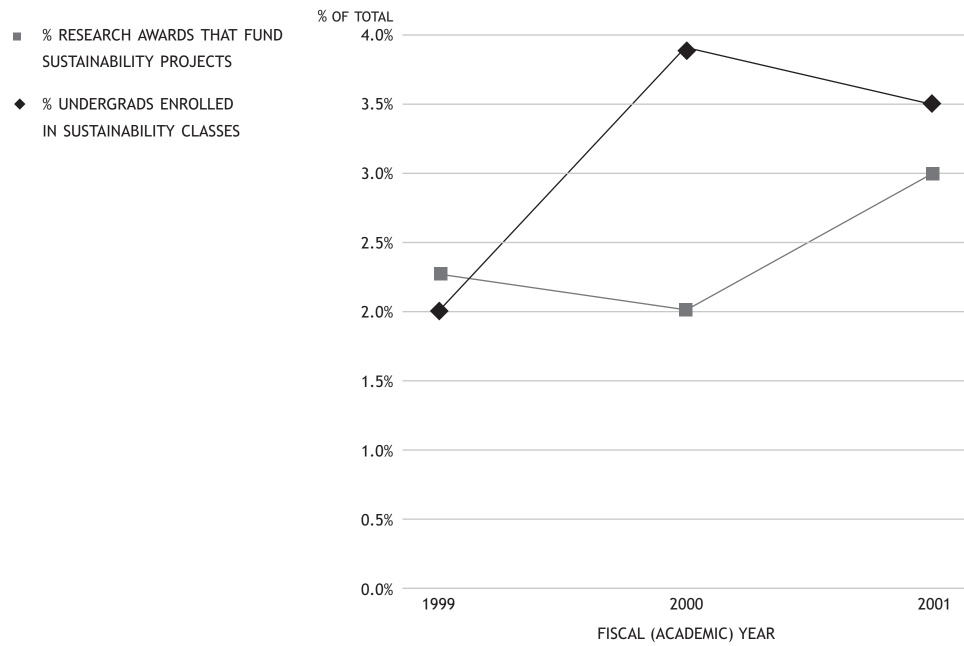
- CLASS DOES NOT ADDRESS SUSTAINABILITY ISSUES
- ADDRESSES THE BASIC FUNCTIONS OF THE EARTH'S NATURAL SYSTEMS
- ADDRESSES THE CORRELATION BETWEEN HUMAN ACTIVITY AND ENVIRONMENTAL SUSTAINABILITY
- ADDRESSES PRACTICES THAT SUPPORT A SUSTAINABLE LIFESTYLE
- ADDRESSES POLICY STRATEGIES THAT SUPPORT ENVIRONMENTAL SUSTAINABILITY

issues. These results speak to the interest and ability of faculty to integrate sustainability issues into their teaching. Analysis of these results in conjunction with the Faculty and Staff Training results would help to clarify whether or not faculty are equipped with the resources to educate about sustainability. If they are, increased integration of sustainability issues depends upon realigning faculty interest in this area.

Without also looking at enrollment in these classes, a simple proliferation of courses that address sustainability issues is itself not a sure sign that an increasing number of students are being exposed to these issues. INDICATOR 33 reports both the percentage of total undergraduates enrolled in six key introductory-level courses focused on the concept of sustainability and the percentage of total research dollars awarded to U-M AA that was awarded to research related to sustainability issues. Key introductory classes were identified with the assistance of the Director of U-M AA's Environmental Studies Program within LS&A. Research related to sustainability issues was identified by searching the Programmed Research Information System at Michigan (PRISM) database for research project titles containing six sustainability keywords (sustainability, environmental, social, justice, equity, rights, and diversity). These two percentages allow an assessment of the degree to which two of the U-M AA's principal products – graduates and primary research – have been exposed to sustainability issues. Both percentages understate true exposure. Undergraduate enrollment in key introductory classes does not capture those undergraduates who place out of introductory classes and proceed directly to upper level sustainability classes, and excludes graduate education in sustainability. Funds awarded to sustainability research captures only those funds awarded to research projects containing one of several sustainability "keywords" in the project title. Nonetheless, this indicator does allow for a baseline estimation.

Undergraduate enrollment has fluctuated around 24,500 since FY 2000[XLI], registering at 24,475 in FY 1999, 24,412 in FY 2000, and 24,547 in FY 2001[XLII]. At the same time, enrollment in the key undergraduate sustainability classes at the U-M AA nearly doubled between FY 1999 and FY 2000. During the last three fiscal years, the proportion of new research awards obtained for projects related directly to sustainability remained small but did increase, from 2.2% in FY 1999 to 2.9% in FY 2000. In raw numbers, research dollars

Indicator 33 Sustainability in Curriculum and Research



awarded to sustainability projects increased during both years, from $9.5 million in FY 1999 to $12.7 million in FY 2000 to $18.7 million in FY 2001.

In addition to the quantitative indicators presented above, additional qualitative data provide other insights about the integration of sustainability issues into the educational curriculum:

- Recent creation of undergraduate concentration in the environment
- Of 250 total endowed professorships at U-M AA, thirteen are in the fields of environmental and social sustainability
- Dual degree programs, including the Masters of Science (MS)/Masters of Public Policy (MPP) dual degree program between SNRE and the Gerald R. Ford School of Public Policy, and the MS/Masters of Business Administration (MBA) Corporate Environmental Management Program (CEMP) between SNRE and the Business School
- Research centers focusing on sustainability issues, including the Center for Sustainable Systems (CSS), the Center for the Study of Complex Systems (CSCS), the Erb Environmental Management Institute, the Center for Population Planning, and others.

Ultimately, the indicator that would best measure the degree to which sustainability concepts were being integrated into the curriculum would be a measure of the "sustainability literacy" of graduating undergraduate and graduate students. This measure could be obtained through the administration of a brief sustainability quiz to a representative sample of undergraduate and graduate students. This quiz could address both knowledge of sustainability issues and personal behavior in relevant areas such as energy use, transportation habits, material consumption, and others. Trends in students' performance over time would indicate the degree to which efforts to integrate sustainability into the curriculum, are proving successful.

ECONOMIC INDICATORS

4.1 Investments

Indicator 34

Presence or absence of investment policies related to sustainability

The U-M Endowment is a unitized investment pool for the U-M's 3,000 separately administered endowment and quasi-endowment funds. Endowment funds are funds given to the U-M by donors who stipulate that the principal of their gift be maintained in perpetuity. The returns made from investing the principal are used to support U-M activities in accordance with the terms of the gifts. The net assets of the U-M Endowment Fund were valued at $3.5 billion on December 31, 2000, up from $1.1 billion in December 1994 and $400 million in December 1989. As of June 30, 2000, the endowment was 13th in size among US higher education endowments and 4th among public universities.

Management of the U-M Endowment Fund impacts all dimensions of the U-M AA's triple bottom line. Endowment Fund Distributions contribute approximately 7% of the U-M's overall operating revenues, making management of the Fund an important component of the U-M's economic sustainability. Because the economic sustainability of the Endowment Fund is analyzed by the U-M AA in its annual financial statements, this report will focus on assessing the ways in which management of the U-M Endowment Fund impacts the system's environmental and social sustainability. The financial instruments in which Endowment Funds are invested will themselves have impacts on the environmental and social sustainability of the companies they fund.

Policies governing management of the Endowment Fund are set by the U-M's Board of Regents. These policies stipulate that the endowment be managed with a long-term investment horizon that allows for investment in a diversified,

Indicator 34 Presence or Absence of Investment Policies Related to Sustainability

U-M does not have any formal policies regarding the environmental and/or social sustainability of its Endowment Fund investments.

equity-oriented portfolio that includes bonds, cash equivalents, and alternative assets, including venture capital, private equity, real estate, and energy (oil and gas) investments. The investment portfolio includes investments in the US and other developed markets, and also investments in emerging economies. The endowment is invested both in pooled funds and in directly held equities. As of June 30, 2001, the U-M AA held equity positions in over 950 different public companies. Indicator 34 reports the presence or absence of internal policies and/or procedures that allow the U-M AA to analyze the impact that its investments have on global environmental and social sustainability thus represents an important indicator of the U-M AA's sustainability.

According to the Investment Office and the findings of the Ad Hoc Advisory Committee on Tobacco Investments, endowment investment decisions are generally based solely on financial factors such as risk and return, and no consideration is given to whether or not the activities of a given corporation in which the U-M Endowment funds are invested are inconsistent with the values of the U-M. However, the U-M AA has made two exceptions to this policy over the course of its history. In the late 1970's, the Chief Financial Officer requested that the Senate Assembly Advisory Committee on Financial Affairs review the issue of U-M AA endowment holdings of companies doing business in South Africa. At the time, global condemnation of the South African policy of apartheid was prompting many public and private institutions to divest their holdings of companies doing business in South Africa. The Committee's report upheld the policy of investment to maximize return, but noted that in certain "compelling" cases, exceptions should be made. In March 1978, the Board of Regents agreed with the Committee that the South African case constituted one such exception, and passed a Resolution divesting the Endowment portfolio of South Africa-related holdings. The Resolution also created a procedure for addressing future cases where moral or ethical concerns about the investment of the U-M endowment existed. This procedure, which was invoked by the Ad Hoc Advisory Committee on Tobacco Investments, consists of the following three steps:

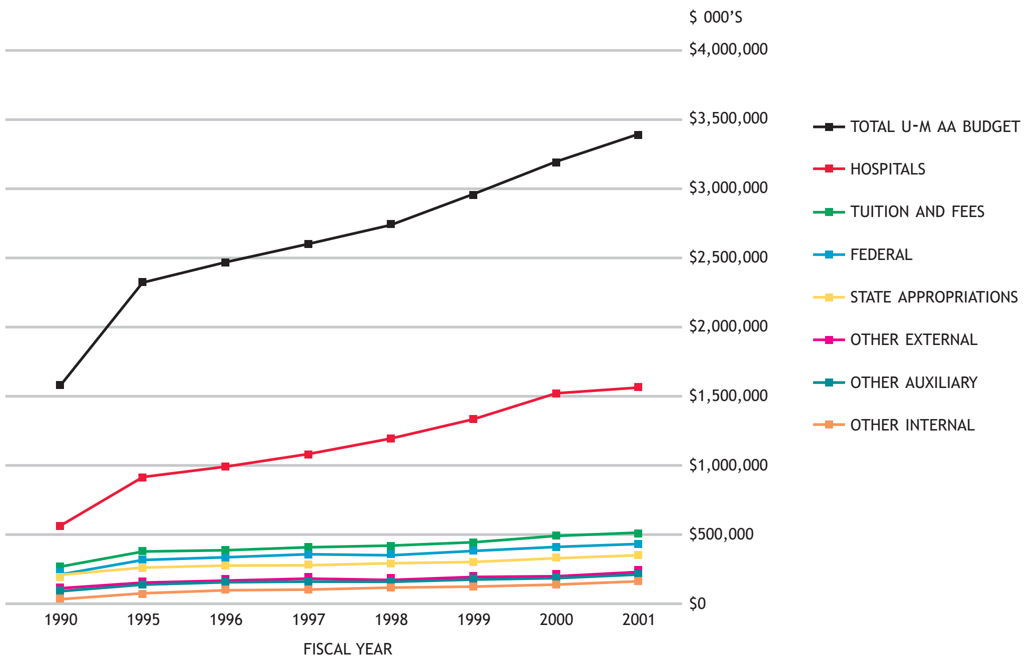
1. Determination by the Board of Regents that an issue involves serious moral and ethical issues of concern to many members of the U-M community,

2. Convening of an advisory committee of diverse stakeholders appointed to gather information and make recommendations, and

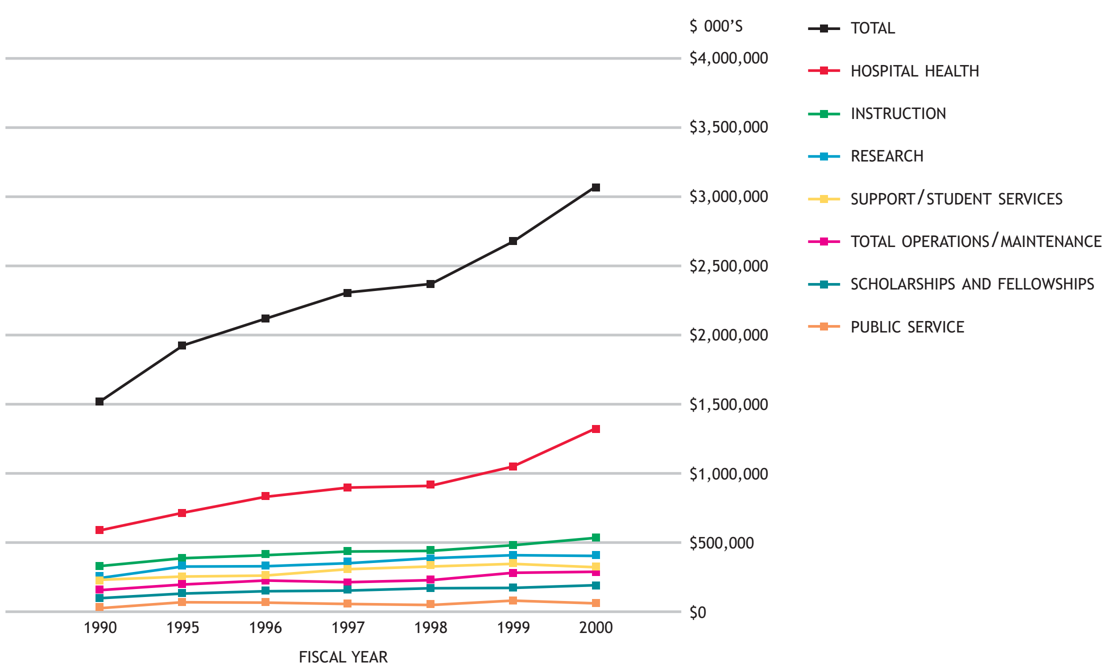
3. Vote by Regents to accept or decline committee recommendations.

Using this procedure, the Board of Regents determined in 2001 that the continued holding of tobacco industry securities constituted an activity "antithetical" to the core missions of the U-M, and voted to divest all tobacco-related holdings.

Indicator 35 Total Revenues by Source (includes Flint, Dearborn, healthcare subsidiaries, wholly owned subsidiaries)



Indicator 36 Total Expenditures by Destination (includes Flint, Dearborn, healthcare subsidiaries, wholly owned subsidiaries)



> *"The goal of economic indicators within the context of this assessment is to allow the University to ensure that it is maintaining a level of transparency with stakeholders."*

4.2 University Revenues and Expenses

Indicator 35

Total Revenues by source
(includes Flint, Dearborn, healthcare subsidiaries, wholly owned subsidiaries)

Indicator 36

Total expenditures by destination
(includes Flint, Dearborn, healthcare subsidiaries, wholly owned subsidiaries)

It is difficult to define the sources of income and the allocation of financial resources that are appropriate for describing a direction that leads to sustainability. A stable source of revenue today may not hold the same stability in the future. Likewise, the level of need in areas requiring allocation of resources may change over time. For this reason, financial indicators that provided information useful for identifying overall trends in revenue receipts and allocation of resources were developed. Rather than making a specific statement about sustainability, these indicators provide a tool for communicating the alignment of goals with the revenues and resource allocations.

U-M AA currently shares a wide range of financial information with the public. The goal of economic indicators within the context of this assessment is to allow the University to ensure that it is maintaining a level of transparency with stakeholders. The indicators were designed to be presented in a manner that allows readers unfamiliar with accounting methodology to easily identify where money is coming from and where it is going. It is hoped that the University can use these indicators to share progress over stated goals in a manner that reaches more of the community than a typical release of financial information might.

The financial growth of the University is demonstrated by the advancing total revenue curve depicted in INDICATOR 35. For FY 2001, total University revenue was $3.403 billion. The graph demonstrates the influence of the University hospital and healthcare system on overall University revenues. With 2001 revenue of $1.567 billion, the hospital and healthcare system represents 46% of total revenues (INDICATOR 35). The hospital system is nationally recognized as a premier organization, and as mentioned in the rationale section, the University should ensure that its stakeholders are aware of the importance of this part of U-M AA and confirm that the current trend fits with community perception of the overall objectives.

As expected, University expenditures have grown along with revenue. Indicator 36 indicates that the marked increase in University expenditures over the past three years, to the current year 2000 total of $3.03 billion, is primarily associated with hospital expenditures and increases in instruction. Hospital/health expenditures do not include University sponsored research, which is captured in the research category of this graph. Readers should note that the economic sustainability of University operations require revenues to meet or exceed expenditures in any given year.

CONCLUSION

The thirty-six indicators presented in this report provide a baseline of information about U-M AA's past and present sustainability performance that can be used to inform decision-making and the establishment of goals for the future. Viewed collectively, they paint a mixed picture of sustainability at the U-M AA, with some indicators showing improving performance and others identifying a trend counter to sustainability. This report did not attempt to prioritize the thirty-six indicators according to importance, as sustainability involves balancing performance and making trade-offs between all of the diverse but equally important areas presented in this report. It is therefore neither possible nor productive to assign an overall sustainability "grade" to the U-M AA. Instead, the information presented for each indicator can be used to guide decision-making and prioritization of areas for further study.

As discussed throughout the report, information-gathering for the indicators was complicated by several factors. First, complete information for the full geographic boundary and time period identified was not available for many indicators, including the energy indicators, food consumption, non-discrimination, and others. In these cases, existing data were used, and extrapolations were made using clearly stated assumptions. Second, identification of the information to be gathered had to be subjective, rather than objective, for several indicators, including sustainability in education and quality of management. Third, the process of data gathering for several indicators was or would have been so time consuming that only a subset of or proxy for the actual information sought could be collected and processed. The indicators to which this factor applies include hazardous waste (data available but collection was time consuming), sustainability in education (ideal information would have been time consuming to gather), and others. These and other limitations related to specific indicators are addressed in the larger Masters Project of which this report is a part.

More broadly, the framework for assessing sustainability introduced in this report can be used as the foundation for future assessments of sustainability at the U-M AA. However, both the framework structure and the collection of indicators that it contains can and should be regularly refined as information needs change and understanding of sustainability issues increases. Regular sustainability assessments will allow the U-M AA to monitor the success of its sustainability initiatives and identify new areas of opportunity. As such, it is an integral step on the journey toward a more sustainable campus. In addition, regular publication of the results of future assessments will establish a reliable and transparent channel of communication between the U-M AA and the wide variety of internal and external stakeholders interested in the U-M AA's sustainability performance.

Finally, concerns about environmental, social and economic issues are being voiced with increasing frequency on university campuses across the nation. As one of the most respected public institutions in the United States, U-M AA is uniquely positioned to address these issues, and to lead the way among universities in the continuing evolution toward a sustainable campus.

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[xxxvi] There is much debate about Hispanic as a race. There is a recent trend recognizing it as an ethnicity, due to a court decision and it is very likely that this category will be eliminated from the next population census.

[xxxvii] The same argument presented for Hispanics could be made in favor of Asians. Although less diverse than Hispanics, they are a group comprised by several races.

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